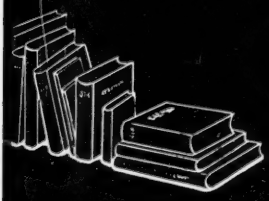
ABSTRACTS OF NORTH AMERICAN GEOLOGY



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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

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ABSTRACTS

02817 **Abbey, Sydney.** Analysis of rocks and minerals by atomic absorption spectroscopy—Pt. 1, Determination of magnesium, lithium, zinc and iron: Canada Geol. Survey Paper 67-37, 35 p., tables, 1967.

Following a brief description of the principles of atomic absorption spectroscopy, methods are described for determining magnesium and iron as major constituents, and zinc and lithium as minor constituents, in rocks and minerals. These methods not only serve to illustrate the potential sensitivity, precision and simplicity of this technique, but also to illustrate unexpected interferences and other limitations.—Author's abstract

02718 **Abelson, P. H.; Hare, P. E.** Action of 2537 A radiation on HCN solutions: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 358-360, tables, 1967.

The authors discuss one possible kind of prebiologic chemical reaction series that could occur at ordinary temperature in dilute solutions at pH 8 or 9 which could produce carbon–carbon bonds under laboratory conditions. Polymerization of HCN is feasible, it can be readily produced, and is stable at high temperatures. In slightly alkaline solution HCN combines with itself to yield several interesting compounds, among which is glycine. When such a solution is irradiated with 2537A radiation and the product mixture hydrolyzed, glycine, alanine, serine, and aspartic acid result. These chemical reactions are significant in determining the chain of chemical events on the primitive Earth that lead to the origin of life.—MST

02730 **Abelson, P. H.** Chemical events on the primitive Earth: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 358, 1967.

The author presents alternative views to the currently accepted idea that the primitive Earth was surrounded by a dense atmosphere of methane and ammonia which by irradiation produced a number of biologically useful compounds. The views are based on the suggestion that the Earth's atmosphere and the oceans are the result of outgassing volatiles which would react with the alkaline crust to form an ocean with a *p*H of 8 or 9 and an atmosphere of CO, CO_2, N_2, and H_2. Radiation interacting with such a mixture yields HCN as a principal product. Ultraviolet irradiation of HCN solutions at *p*H 8 to 9 yields amino acids and other important substances of biologic interest. Arguments concerning feasible components support the view that amino acids and proteins preceded sugars and nucleic acids.— MST

02731 **Abelson, P. H.; Hoering, T. C.** Irradiation of mixtures of CO, N_2, and H_2: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 360-362, tables, 1967.

To obtain an indication of the kinds of volatile chemicals that might be synthesized by the energy of sunlight radiation on the primitive atmosphere of the Earth, the authors performed experiments using an electric discharge producing high temperatures and short ultraviolet radiation qualitatively similar to the effects of solar radiation. HCN was the principal product, although small amounts of other substances were seen. Formaldehyde concentrations were less than 10^{-3} those of HCN. The presence of water vapor diminished yields of HCN in only moderately reduced systems. HCN is produced abundantly only when the system is sufficiently reducing. When such mixtures are irradiated under conditions similar to those that

may have prevailed at the top of the primitive atmosphere, however, HCN is an abundant and major product.—MST

Adams, R. F. *See* Tuthill, L. H. 02890

02832 **Agterberg, F. P.; Hills, L. V.; Trettin, H. P.** Paleocurrent trend analysis of a delta in the Bjorne Formation (Lower Triassic) of northwestern Melville Island, Arctic Archipelago: Jour. Sed. Petrology, v. 37, no. 3, p. 852–862, illus., 1967.

Trend analysis, by method of least squares applied through a computer program to geographic location average sedimentary structure orientation data from the Bjorne Formation, yields computer-plotted orientation trends or vectors. Interpretation of the vectors suggests the presence of a paleodelta, the location of the apex of the delta, and directions of movement of sediment across the delta. The computed trends tend to obscure local data which may be geologically significant even if not statistically significant. The method is suggested for application also to strike and dip data to obtain generalized geologic structure interpretations.—RAC

Ahlrichs, J. L. *See* Weismiller, R. A. 02994

02427 **Ahrens, Thomas J.; Syono, Yasuhiko.** Calculated mineral reactions in the earth's mantle: Jour. Geophys. Research, v. 72, no. 16, p. 4181–4188, illus., tables, 1967.

Thermochemical and compressibility data are used to calculate approximate pressures and temperatures required for reaction of clinoenstatite to spinel or olivine or to periclase and stishovite, reaction of forsterite to spinel or periclase and stishovite, and breakdown of spinel to periclase and stishovite. Calculated reaction lines for Mg_2SiO_4 (olivine)$\rightarrow$2 $MgO+SiO_2$ and $MgSiO_3\rightarrow MgO+SiO_2$ lie at higher pressures than previously estimated, and probably do not take place in the Earth's mantle. It appears, rather, that reactions Mg_2SiO_4 (olivine)$\rightarrow Mg_2SiO_4$ (spinel), Mg_2SiO_4 (spinel)$\rightarrow$2 $MgO+SiO_2$, and 2 $MgSiO_3\rightarrow Mg_2SiO_4$ (spinel)$+SiO_2$ take place along $p=110\pm11+0.024T$, $p=321\pm38-0.013T$, and $p=133\pm19+0.039T$, respectively.—*from* Authors' abstract

Albee, Arden L. *See* Sheridan, Douglas M. 02768

02827 **Albin, Donald R.; Hines, Marion S.; Stephens, J. W.** Water resources of Jackson and Independence Counties, Arkansas: U.S. Geol. Survey Water-Supply Paper 1839-G, p. G1–G29, illus., tables, 1967.

The present (1965) water use in Jackson and Independence Counties is about 55.6 million gallons per day, and quantities sufficient for any foreseeable use are available. Supplies for large-scale uses can best be obtained from wells in the Coastal Plains and streams in the highlands. Coastal Plain wells yield 1,000–2,000 gpm when screened at depths of 100–150 feet in Quaternary alluvium. Wells in the highlands generally yield less than 50 gpm of water of good quality, though hard. The White River, its tributaries in the Salem and Springfield Plateaus section, and Polk Bayou can be utilized with little or no artificial storage required. Streams in the Boston Mountains and in the Arkansas Valley sections recede to very low flow during dry periods, but dependable supplies can be obtained by constructing storage facilities.—*from* Authors' abstract

Aldrich, L. T. *See* Davis, G. L. 02736

Alexander, Shelton S. *See* Phinney, Robert A. 03013

02800 **Allen, P. B.; Welch, N. H.** Sediment transport of streams in the Washita River basin in Caddo and Grady Counties, Oklahoma: Water Resources Research, v. 3, no. 3, p. 777–784, illus., tables, 1967.

Sediment yields for nine experimental watersheds, whose drainage areas vary from 26 to 3,290 sq mi, were related to the geology of the watersheds. Yields from watersheds with mixed sandstone, siltstone, and shale geology were higher than those with predominantly sandstone. The highest yield rate was 29.7 inches per 1,000

years for a mixed geology watershed, the lowest being 1.32 for a sandstone watershed. Stream channel shape was found to be related to the material in transport. Streams with large sand loads have wide, shallow channels, whereas streams with a predominantly silt sediment concentration was +0.93. Computations of total load predictions by the modified Eistein and Colby method compared favorably with those made by the Brooks method.—*from* Authors' abstract

02796 **Alvarado Ortuño, Jorge E.** Estudio geológico del área Teopisca Comitán, Chiapas: Geología y Metalurgía, v. 3, no. 19, p. 13–61, illus., 1967.

Teopisca Comitán, an area of 2,000 sq km in the state of Chiapas, Mexico, is in the frontal ranges of the Sierre Madre and in the Depresión Central (altitudes: 3200 and 500 m, respectively). The sediments are middle Cretaceous (Cantelá limestone), Upper Cretaceous (Jolpabuchil limestone), Paleocene, Eocene (El Bosque formation), upper Eocene, and Recent. Structurally, there are three principal faults and eleven major NW–SE trending anticlines which probably developed during Laramide (Paleocene) and Cascadian (Pleistocene) Revolutions. Potential resources are iron oxide from the El Bosque, aluminum, iron, calcite, and travertine. It is recommended that the area be explored for petroleum, that a test hole be drilled first in the San Cristóbal anticline, and that the economic potential of the rocks and minerals be investigated thoroughly.—LLP

02706 **Am. Society of Civil Engineers.** (Soil Mechanics Div., Comm. Inf. Retrieval). Information retrieval for soil engineers: Am. Soc. Civil Engineers Proc., v. 93, paper 5471, Jour. Soil Mechanics and Found. Div., no. SM5, pt. 2, 180 p., 1967.

Authors of soil mechanics literature must facilitate the transfer of information to others by using concise titles, writing informative abstracts, and providing key-word index terms from the Soil Mechanics Thesaurus. This is because computers are no substitute for intellectural effort, and the cost of professional abstracting and indexing is prohibitive. Part A of this report gives suggestions for this and Part B for filing and retrieval systems; Part C contains the Soil Mechanics Thesaurus, using 1,550 approved descriptors and their cross references—GDC

02820 **Amstutz, G. C.; Park, Won C.** Stylolites of diagenetic age and their role in the interpretation of the southern Illinois fluorspar deposits [with German abs.]: Mineralium Deposita, v. 2, no. 1, p. 44–53, illus., 1967.

The problem of the time of formation of stylolites is discussed briefly and a descriptive and megascopic classification is offered. Detailed field and microscopic observations of stylolite seams in carbonate host rocks and fluorite–sphalerite bearing rocks of the southern Illinois fluorspar district indicate that stylolites formed during various stages of diagenesis. Carbonate, silica, fluorite and sphalerite occur frequently near or along the stylolite seams; recrystallization, dissolution, grain growth, grain orientation, pressure-twinning, fracturing and residual accumulation of the minerals are observed along stylolite seams. A paragenetic sequence of ore and rock minerals has been derived; sphalerite and fluorite appear to have formed during the diagenesis of the ore-bearing carbonate rocks.—*from* Authors' abstract

Anders, Edward. *See* Larimer, John W. 02490

02470 **Anderson, C. A.** Precambrian wrench fault in central Arizona, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C60–C65, illus., 1967.

The major north-trending high-angle Shylock fault zone, 17 miles east of Prescott, Ariz., displaces Precambrian rocks. It is interpreted as a wrench fault with a minimum right-lateral slip of five miles. A piercement structure in the fault zone is implied by a fault slice of tightly folded and highly deformed incompetent rhyolitic tuff and slate that is in contact with younger andesitic breccia and tuff. The fault zone is covered by unbroken Cambrian Tapeats Sandstone at its north end. Author's abstract

Anderson, D. M. *See* Reynolds, R. C., Jr. 02861

02938 **Anderson, David N.** Shale Point Gas field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1966, v. 52, no. 2, pt. 2, p. 13–17, illus., tables, 1967.

Approximately 3,800 feet of sedimentary rocks, dominantly sandstone, has been penetrated in the Shale Point field; units range in age from Paleocene to Recent with the depositional sequence interrupted by four unconformities. Regionally the structure is a series of folds lying generally parallel to the Temblor Range on the southwest. Gas accumulation is in a stratigraphic trap formed by the pinching-out of the Eocene Mabury sandstone on the valleyward flank of the last fold mappable on the surface; a reverse fault lies along the west edge. The Mabury sandstone, the only producing zone in the field, is found at an average drilled depth of 3,400 feet and is of variable thickness. A structure map shows contours on "C" electric log marker.—MCM

02939 **Anderson, David N.** Shale Flats Gas field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1966, v. 52, no. 2, pt. 2, p. 19–22, illus., tables, 1967.

The general description for the Shale Point gas field (ibid., p. 13–17) covers the Shale Flats field as well. The productive horizon is the Mabury sandstone at an average drilled depth of about 2,800 feet.—MCM

Anderson, Don L. *See* Toksöz, M. Nafi. 02503

02504 **Anderson, Don L.** A seismic equation of state, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 9–30, illus., tables, 1967.

Birch's hypothesis of the close relation between velocity and density is extended and modified to agree with theoretical predictions concerning the form of the equation of state. An equation of state is derived which is of general utility in geophysical studies where seismic velocities are the directly measured variables. Data from static compression, shock wave, or ultrasonic experiments can be used to determine the parameters in the equation of state and extend its range. The general tendency of density to increase with Φ can be used to determine the density in the C-region even if it is a region of phase changes. New density models for the Earth are constructed on these considerations.—DBV

02670 **Anderson, Don L.** Phase changes in the upper mantle: Science, v. 157, no. 3793, p. 1165–1173, illus., tables, 1967.

In western North America the transition regions of the C region of the upper mantle start at depths of 365 and 620 km and involve velocity increases of about 9–10 percent. Their location, shape, and thicknesses are consistent with, first, the transformation of Mg-rich olivine to a spinel structure and then, a further collapse of a material having approximately the properties of the component oxides. The velocity increases associated with each transition region are slightly less than predicted; this can be interpreted in terms of increasing fayalite content with depth. The depths of the transition regions are consistent with temperatures near 1,500°C at 365 km and 1,900°C at 620 km.—DBV

02821 **Anderson, Duwayne M.** Phase composition of frozen montmorillonite-water mixtures from heat capacity measurements: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 218, 10 p., illus., tables, 1967.

Equations are written that form the basis of a method for determining the unfrozen water content of frozen clay-water mixtures from heat capacity measurements. The heat capacity of frozen sodium-montmorillonite water mixtures was determined at -4.7° and -9.6°C with a Calvet Microcalorimeter. The data were then used in conjunction with the method described to obtain the unfrozen water content of these clay-water mixtures. The data obtained indicate that the method is applicable at temperatures below about -5°C. The amount of unfrozen water found in the frozen clay-water mixtures at -5° to -10°C is equivalent to an interfacial surface layer of water of from one to two molecular diameters in thickness. Most of this water

can be accomodated and is thought to be located in interlamellar regions.—Author's summary

Anderson, Henry W. *See* Yamamoto, Teruo. 02801

03022 **Anderson, K. H.; Wells, J. S.** The heavy oil situation in western Missouri [abs.]: Shale Shaker, v. 18, no. 1, p. 14, 1967.

Anderson, R. E. *See* Rogers, C. L. 02555

Angelo, Clifford G. *See* Feulner, Alvin J. 02590

02954 **Angino, Ernest E.** Dissolved salts in oil-field brines—A wasted resource?, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 120–124, illus., 1967.

Processes for the production of calcium, magnesium, sodium, potassium, iodine, chlorine, and bromine from many brines are being successfully applied. Fresh water could well be an additional byproduct. Of particular interest are those processes that remove calcium and magnesium for use as fertilizers. Of the billions of barrels of oil-field brine brought to the surface yearly, about 50 percent are returned to the subsurface with no attempt to strip the salts. Their concentration is considerably higher than in sea water, as shown in a table; two highly mineralized Kansas brines from the Topeka and Cherokee Formations of Pennsylvanian age are compared. The fortuitous location of these raw materials and the advantage of having the brines already brought to the surface, warrant further research on the possibilities of their exploitation.—GDC

Angino, Ernest E. *See* Kansas Geological Survey. 02963

02483 **Annell, Charles.** Spectrographic determination of volatile elements in silicates and carbonates of geologic interest, using an argon d-c arc, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C132–C136, illus., tables, 1967.

A quantitative spectrographic method using a d-c arc in an argon atmosphere to determine trace amounts of Ag, Au, Bi, Cd, Ge, In, Pb, Sb, Tl and Zn in geologic samples is described. A 20-mg sample is mixed with 30 mg of anhydrous Na_2CO_3 and 5 mg of powdered graphite. The mixture subjected to a 25 amp d-c arc in an ambient argon atmosphere generally gives lower detection limits than those obtained with normal air arcings. Detection limits, in parts per million, are: Ag, 0.20; Au, 0.25; Cd, 8; Sb, 100; Zn, 4, and the remaining elements, 1.—Author's abstract

03008 **Archambeau, C. B.; Flinn, E. A.; Lambert, D. G.** Detection, analysis and interpretation of teleseismic signals—Compressional phases from the Bilby, Shoal and Fallon events [abs.], *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 369–370, 1967.

02556 **Arulanandan, Kandiah.** Electrical response characteristics of clays and their relationships to structure [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3921B–3922B, 1967.

Austin, George. *See* Parham, Walter. 02865

02550 **Ayres, L. D.** Trout Lakes area, South Trout Lake sheet, District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 422, scale 1 in. to 1/4 mi., text, 1967.

Stratigraphy and structure of the metavolcanic and metasedimentary rocks of the Trout Lake area have not been completely deciphered, but formations are probably early Precambrian in age. Near South Trout Lake they have been tentatively subdivided into lower mafic volcanics, middle metasediments, and upper mafic

metavolcanics. Sills and rare dikes of metagabbro and metadiorite are most abundant in the metasedimentary formation near the east end of South Trout Lake. The metavolcanic–metasedimentary sequence has been isoclinally folded into an east- to southeast-trending syncline. Narrow quartz veins which contain rare sulfide mineralization are found in all rock types. Grab samples showed traces of gold, copper, lead, nickel, and zinc.—MCM

02803 **Ayrton, S. N.; Burri, M.** L'évolution du socle Précambrien dans la région de Qagssimiut, Groënland méridional [with English and Russian abs.]: Medd. om Grønland, v. 175, no. 2, 92 p., illus., table, geol. map, 1967.

Most of the area is Precambrian Shield and has a very complex history. Quartzite and amphibolite schists, now occupying a minor part of the area, were subjected to at least two periods of deformation, then to intrusion by ultrabasic massifs and plugs. Widespread granitization followed, transforming pre-existent rocks into granite, the principal rock type of the area. Basic intrusion occurred as sheets and dikes, mainly in the south, some veined and replaced by granite. Characteristics of this static replacement of basic material by acid are described in some detail; the alternate phases of basic intrusion and granitization under stable conditions is remarkable. Emplacement of small massifs of microgranite preceded the Gardar, characterized by intrusion of basic dikes and block faulting. After a long hiatus two generations of dolerite dikes (Tertiary?) were intruded.—ESL

02948 **Backus, G. E.; Gilbert, J. F.** Numerical applications of a formalism for geophysical inverse problems, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 247–276, illus., tables, 1967.

A gross datum of the Earth is a single measurable number describing some property of the whole Earth, such as mass, moment of inertia, or the frequency of oscillation of some identified elastic–gravitational normal mode. We prove that the collection of Earth models which yield the physically observed values of any independent set of gross Earth data is either empty or infinite dimensional. We exploit this very high degree of non-uniqueness in real geophysical inverse problems to generate computer programs which iteratively produce Earth models to fit given gross Earth data and satisfy other criteria. We describe techniques for exploring the collection of all Earth models which fit given gross Earth data. Finally, we apply the theory to the normal modes of elastic–gravitational oscillation of the Earth.—Authors' summary

02947 **Backus, George E.** Converting vector and tensor equations to scalar equations in spherical coordinates, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 71–101, 1967.

We show how to represent a vector field in a spherical shell in terms of three scalar fields, and a second-order tensor field in terms of nine scalar fields. We derive the scalar representations of the most common algebraic and differential operations on vector and second-order tensor fields, and apply the results to obtain scalar formulations of various tensor problems in the continuum mechanics of the Earth's mantle. We give an exhaustive catalog of all possible equilibrium stress fields in the mantle, we deduce the scalar equations of elastic–gravitational oscillation of a transversely isotropic, radially stratified, spherically symmetrical Earth, and we give the scalar convection equation for a viscous, self-gravitating spherically symmetrical mantle with radially variable viscosity.—Author's summary

Bailey, Edgar H. *See* Wollenberg, Harold A. 02437

Baker, B. L. *See* Hodgson, G. W. 02774

Baker, D. W. *See* Wenk, H. R. 02683

02776 **Baker, E. G.** A geochemical evaluation of petroleum migration and accumulation, Chap 7 *in* Fundamental aspects of petroleum geochemistry (B. Nagy

and U. Colombo, editors): Amsterdam and New York, Elsevier Publishing Co., p. 299–329, illus., tables, 1967.

In the common belief that oil is formed in fine-grained sediments, original emphasis is on its primary migration essentially inviolate out of the source rock into a more porous reservoir. Its movement has been suggested at saturations completely disallowed by field and laboratory experience of the reservoir engineer. In this chapter, a possible mechanism is outlined which employs certain physico-chemical processes, with water expelled by compaction, as the vehicle. For the release and concentration of hydrocarbons, an in situ salt-filtering mechanism is suggested. Difficulty lies in measuring the solubility of oil in water, which varies with compositional distribution of hydrocarbons.—GDC

Ball, R. H. *See* Kahle, Anne B. 02991

Ball, R. H. *See* Vestine, E. H. 02992

02708 **Bara, John P.; Hill, Ronald R.** Foundation rebound at Dos Amigos Pumping Plant: Am. Soc. Civil Engineers Proc., v. 93, paper 5439, Jour. Soil Mechanics and Found. Div., no. SM5, pt. 1, p. 153–168, illus., 1967.

In a deep excavation, the subsoils rebound or heave as a function of depth, soil properties, and environment. To date, foundation rebound cannot be predicted from laboratory tests with confidence. The deep excavation for the Dos Amigos Pumping Plant, in the Central Valley of California, provided an opportunity to gain more knowledge in this field. Reference points were installed in the foundation soil so rebound could be measured during and after excavation. The measured total rebound compared favorably with the calculated rebound based on laboratory testing; however, if the calculated rebound is adjusted for time, the correlation is poor.—GDC

02937 **Barger, R. M.; Sullivan, John C.** Willows-Beehive Bend Gas field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1966, v. 52, no. 2, pt. 2, p. 5–12, illus., tables, 1967.

The oldest formation in the Willows-Beehive Bend gas field, near the center of the Sacramento Valley geosyncline, is the Cretaceous Venado which is about 1,150 feet thick. The productive area is bounded on the west by the prominent reverse Willows fault, traced for a distance of 20 mi and probably related to other reverse faults along the western margin of the valley; within the field it has a displacement of more than 1,000 feet. The major gas reservoirs are in the Cretaceous Kione and Forbes Formations; the latter has a total of 81 wells and production is obtained at random from almost its entire thickness. All sand lenses have well-defined limits and faulting, although common, is of secondary importance in controlling accumulation. A structure map shows contours on top of the Cretaceous Guinda Formation.—MCM

02435 **Barnes, Farrell F.** Coal resources of the Cape Lisburne-Colville River region, Alaska: U.S. Geol. Survey Bull. 1242-E, p. E1–E37, illus., tables, geol. map, 1967.

Coal is widespread in northern Alaska in rocks of Cretaceous age that have been moderately folded and faulted in the foothills belt near the mountains but are flat or gently folded under the coastal plain to the north. Estimated coal resources total 120,197 million tons, of which 19,292 million tons are bituminous in rank and 100,905 million tons are subbituminous. The bituminous coal occurs in rocks of mid-Cretaceous age in the foothills belt, and the subbituminous coal in rocks of the same age under the coastal plain and in rocks of Late Cretaceous age in the eastern part of the report area.—FFB

02940 **Barnes, J. A.** Main area of Edison oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1966, v. 52, no. 2, pt. 2, p. 31–43, illus., tables, 1967.

The stratigraphic sequence present in the southeastern San Joaquin Valley is only partially represented in the Main area of the Edison field; the stratigraphic column

(Jurassic basement complex to Recent alluvium) shows only those unconformities that are recognized over the entire area under discussion. The dominant structure is an uplifted, southwesterly tilted fault block in the basement complex. The producing zones, Kern River–Chanac, Santa Margarita, Wicker, Nozu, Freeman–Jewett, Walker, and Schist, are often produced in various combinations, making difficult the determination of gravity, water cut, and productive capabilities for individual zones. For the same reason it is impossible to arrive at accurate cumulative production figures for each zone.—MCM

Barsvary, A. K. *See* Stermac, A. G. 02762

Barton, R., Jr. *See* Donnay, Gabrielle. 02647

02950 **Bates, Robert L.** Geometry of deposits of the sedimentary nonmetallics, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 45–50, illus., 1967.

Nonmetallic deposits of sedimentary origin are found to occur mainly as sheets and lenses, and to a minor degree in other forms. Sheets are of wide lateral and limited vertical extent, and present relatively few geologic complexities. Small lenses are of quarry width and the largest grade into sheet deposits. All major lenses are buried, and all have been found by accident, in drilling for oil or water. Lenses present numerous problems of origin and detection. Minor sedimentary forms include a sedimentary pinch-out, deposits in the zone of weathering of outcropping flat strata, and erosional remnants. Examples of all these geometric types are described.—Author's abstract

Bath, Jennifer. *See* Matthews, D. H. 02581

02452 **Bathurst, R. G. C.** Oölitic films on low energy carbonate sand grains, Bimini Lagoon, Bahamas: Marine Geology, v. 5, no. 2, p. 89–109, illus., tables, 1967.

Grains with thin (2μ) oölitic coats are particularly abundant in the southeastern part of Bimini Lagoon. Turbulence is low and sediment movement is restricted by a dense benthos of *Thalassia*, Algae, and a subtidal gelatinous mat that binds the carbonate grains together at the sediment surface. The region has the shallowest water in the lagoon, the highest content of fine sand, and grains are well-rounded and intensively bored by Algae.—Author's abstract

02788 **Bay, Roger R.** Factors influencing soil-moisture relationships in undrained forested bogs, *in* Forest hydrology—Natl. Sci. Found. Advanced Sci. Seminar, University Park, Pa., 1965, Proc.: London and New York, Pergamon Press, p. 335–343, illus., 1967.

Saturated bogs or peatlands have received little attention from hydrologists. Studies now underway in northern Minnesota indicate that a number of factors influence soil-moisture relationships in undrained forested bogs. Research in soil physics has shown different physical properties for various peat types which affect water-retention and water-movement rates in bogs. The regional ground-water system and other hydrogeologic conditions in experimental bogs have been related to bog-water variation. Little storage space is available in the spring of the year because of high water tables soon after snowmelt; it is increased later when evapotranspiration losses lower the water table.—GDC

Bayer, T. N. *See* Hogberg, R. K. 02751

02925 **Bayha, David C.** Occurrence and quality of ground water in Montague County, Texas: Texas Water Devel. Board Rept. 58, 102 p., illus., tables, 1967.

Montague County is within the outcrop area of upper Pennsylvanian, lower Permian, and lower Cretaceous formations in north-central Texas. Pennsylvanian and Permian formations in most areas dip north and northwest; in the southeastern half of the county these are overlain by Cretaceous rocks which dip gently southeast. Cretaceous rocks, predominantly sandstone, have a great amount of ground-water

storage capacity. Pleistocene to Recent alluvial sediments occur along streams. Ground water of usable quality is found in most areas; wells range in depth from about 20–1,000 feet. Mineral constituents vary in concentration, but generally can be used to establish the base quality of natural ground water in different areas. Disposal of oil-filed brine is probably an important source of chemical alteration of the native-quality water.—*from* Author's abstract

02863 **Beall, Arthur O., Jr.; Ojakangas, Richard W.** Mineralogy of an Upper Cambrian K-bentonite from Missouri: Jour. Sed. Petrology, v. 37, no. 3, p. 952–956, illus., tables, 1967.

A bentonite in the Lamotte Formation of Cambrian age from Missouri consists of dioctahedral mixed-layer illite-montmorillonite. Heavy minerals from the bentonite are zircon, hornblende, sphene, tourmaline, and epidote and are sharply angular compared to similar heavy minerals in adjacent sandstones.—HAT

Beall, G. H. *See* Wosincki, J. F. 02795

Becher, Albert E. *See* Meisler, Harold. 02595

02429 **Beebe, B. Warren.** Quest for unity—[Pt.] 3, A change in course: Geotimes, v. 12, no. 7, p. 18–20, 1967.

Reorganization of the American Geological Institute began in 1960 with the work of the nearly-100-member steering committee and its executive committee. It was unanimously decided that the AGI was to be a federation of societies without individual members. The main problems were to devise a new constitution and bylaws and to study financial needs and means of providing necessary support. The complete story of the initial reorganization attempt appears in three issues of *Geotimes* for 1960. The reorganized Institute met for the first time in Houston in 1963. Membership now includes 16 member societies. Tributes are paid to several men who have contributed to the success of the Institute.—MCM

02699 **Beevers, J. R.** A method for the determination of the gold content of samples by solvent extraction and atomic absorption spectrophotometry: Econ. Geology, v. 62, no. 3, p. 426–428, illus., 1967.

The method, which employs an organic reagent—p-dimethylamino benzalrhodanine—in the solvent extraction, is rapid, cheap, relatively sensitive, and free from interferences from typical trace elements.—WSW

Bell, P. M. *See* Boyd, F. R. 02726

Bell, Peter M. *See* Richardson, S. W. 02654

02661 **Bell, Peter M.; Davis, B. T. C.** Investigation of a solvus in the system jadeite-diopside: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 239–241, illus., 1967.

Melting relations in the binary system jadeite-diopside were investigated previously to confirm calculations based on the critical temperature of unmixing that indicate a strong pressure dependence; this dependence could be useful in deducing the pressure of formation of natural iron-free omphacites, such as those occurring in some eclogites and metagraywackes. The present investigation sought to test the two-phase formation by unmixing amd mixing crystalline reactants, and to test the calculated pressure dependence by determining a temperature-composition section at 40 kb. The results and their application to pressure of formation of an omphacite used in the experiments are discussed.—MST

02689 **Bell, Peter M.; Roy, Robert F.** Heat flow and gravity measurements at Ajo, Arizona: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 414–415, illus., 1967.

The first value of heat flow reported for Ajo, Arizona, 2.1 cal/cm^2, was high compared with the continental mean, although it was in accord with other measurements in the Basin and Range province. In the present study the heat-flow value for Ajo HS-1 was improved by refinement of the thermal conductivity

measurements, to $2.2\pm0.2\mu cal/cm^2$ sec after corrections for water saturation and temperature effects on thermal conductivity. A second measurement was made for Ajo HS-2 in another exploration drill hole located about 500 m west of HS-1. The corrected heat-flow value for HS-2 is $2.4\pm0.2\mu cal/cm^2$ sec, about 9 percent higher than the HS-1 value. The mean for the two measurements is $2.3\pm0.3\mu cal/cm^2$ sec. This value is interpreted in regional terms.—MST

02728 **Bell, Peter M.; England, J. L.; Kullerud, G.** High-pressure differential thermal analysis: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 354-356, illus., 1967.

The melting relations of sulfur were investigated by DTA to 20 kb pressure. High-purity material was sealed in gold capsules. An invariant point involving the three phases, orthorhombic sulfur, monoclinic sulfur, and the liquid, can be approximately located at $107°\pm2°C$ and 2.5 ± 0.5 kb. The monoclinic sulfur-liquid sulfur univariant curve, contrary to some previous experiments, was found to have a negative slope. The discrepancies between the results of this and previous studies are thought to be due to the difference in experimental procedures, that is, between quenching methods or P-V-T relations, and DTA methods.—MST

Bennett, G. *See* George, P. T. 02901

Berg, Eduard. *See* Carder, Dean S. 02997

Berryhill, H. L., Jr. *See* McKee, E. D. 02857

02583 **Beutner, Edward C.; Flueckinger, Linda A.; Gard, Theodore M.** Bedding geometry in a Pennsylvanian channel sandstone: Geol. Soc. America Bull., v. 78, no. 7, p. 911-915, illus., 1967.

Cross-bedded sandstone in the Pennsylvanian Kittanning Formation of the Allegheny Group exposed in a strip mine near Philipsburg, Pa., consists of large, inclined sigmoid sedimentation units that overlap each other uniformly toward the west. Such features as the arrangement of sedimentation units and their internal bedding geometry suggest that the sandstone originated by deposition on the inside of a meander curve of a westwardly migrating stream channel.—Authors' abstract

02929 **Bird, J. Brian.** The physiography of arctic Canada, with special reference to the area south of Parry Channel: Baltimore, Md., Johns Hopkins Press, 336 p., illus., tables, 1967.

The physiography of arctic Canada south of Parry Channel, the great through-channel that extends from Lancaster Sound to M'Clure Strait, and the Arctic Ocean is examined. The 23 chapters are divided into 4 parts: (1) the background—geologic history, climate, glaciers, permafrost, soils and vegetation; (2) major episodes in landscape development—main elements, drainage systems, Pleistocene glaciation, marine transgression and proglacial lakes; (3) geomorphic processes in the present-day landscape—basic concepts, periglacial rock weathering, minor landforms, mass movement, periglacial patterned ground, geomorphic role of snow and ice, and of river, lake, and sea ice, glacier ice in the contemporary landscape, fluvial and aeolian processes, arctic slopes, and (4) special elements in the landscape—limestone regions, arctic terrain, and arctic coasts.—LLP

02710 **Bjerrum, Laurits.** Progressive failure in slopes of overconsolidated plastic clay and clay shales: Am. Soc. Civil Engineers Proc., v. 93, paper 5456, Jour. Soil Mechanics and Found. Div., no. SM5, pt. 1, p. 1-49, illus., tables, 1967.

All evidence indicates that slides in slopes of overconsolidated clays and clay shales are preceded by the development of a continuous sliding surface by progressive failure. Requisite conditions are related to internal lateral stresses, recoverable strain energy, and residual shear strength. In particular it is proposed that progressive failure may be due to a large content of recoverable strain energy of the clay resulting from its geological history. In clays with weak diagenetic bonds this is immediately recovered upon reduction in load. In clay shales diagenetic bonds were formed at maximum consolidation pressure, and recoverable strain energy is locked-in to

be released only when bonds are destroyed by near-surface weathering. Examples include the Bearpaw shale of Saskatchewan.—GDC

02462 **Blake, M. C., Jr.; Irwin, W. P.; Coleman, R. G.** Upside-down metamorphic zonation, blueschist facies, along a regional thrust in California and Oregon, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C1-C9, illus., 1967.

Low-grade metamorphic rocks of the blueschist facies grade upward to the sole of a great thrust fault along the eastern margin of the Coast Ranges in northern California and southwestern Oregon. The gradation is defined by three textural zones of increasing reconstitution in metagraywacke, and by two metamorphic mineral zones, lawsonite and pumpellyite. The metagraywacke of textural zones 1 and 2 is clearly Franciscan Formation on the basis of lithology and age, and grades into thoroughly reconstituted rocks of textural zone 3 that herein are named the South Fork Mountain Schist. The blueschist probably formed in a zone of cataclasis and anomalously high water pressures under the thrust fault, rather than in the generally postulated zone of extreme depth of burial. Water in excess of that required to form pumpellyite and lawsonite was available for serpentinization of ultramafic rocks emplaced in the thrust fault.—Authors' abstract

Blakely, Robert F. *See* Potter, Paul Edwin. 02837

02448 **Blanchard, R. L.; Cheng, M. H.; Potratz, H. A.** Uranium and thorium series disequilibria in recent and fossil marine molluscan shells: Jour. Geophys. Research, v. 72, no. 18, p. 4745-4757, tables, 1967.

The extent of disequilibrium between certain members of the naturally occurring radioactive heavy element families in recent and fossil marine molluscan shells has been investigated with a view to ascertaining the conditions under which these disequilibria may serve as measures of geologic age. Dating fossil marine carbonates by uranium decay series disequilibrium measurements apparently is sometimes applicable to fossil marine carbonates that have formed and remained in a marine environment, but reliable results are not likely for isolated fossil marine shell specimens from terrestrial environments, due to alteration of their U and Th compositions by contact with ground water.—DBV

02497 **Bloomer, R. O.** Precambrian Grenville or Paleozoic quartzite in the Dekalb area in northern New York—Reply [to discussion of 1965 paper by J. S. Brown, 1967]: Geol. Soc. America Bull., v. 78, no. 7, p. 931, illus., 1967.

In response to Brown (ibid., p. 921-930) the writer reaffirms his original conclusion that the small areas of quartzite in the Dekalb area are Precambrian Grenville Series rather than Paleozoic Potsdam Sandstone.—AG

02864 **Boggs, Sam, Jr.** Measurement of roundness and sphericity parameters using an electronic particle size analyzer: Jour. Sed. Petrology, v. 37, no. 3, p. 908-913, illus., 1967.

The Zeiss electronic particle-size analyzer may be used to obtain the measurements needed to compute roundness as defined by Wadell (1932) and sphericity as defined by Riley (1941) and others. An improvised data record sheet simplifies calculations for each grain.—RAC

02543 **Bond, Thomas Alden.** Palynology of Quaternary terraces and floodplains of the Washita and Red Rivers, central and southeastern Oklahoma [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3988B, 1967.

Bonilla, Manuel G. *See* McCulloch, David S. 02707

02754 **Booth, Verne H.** Physical science—A study of matter and energy (2d edition): New York, Macmillan Co., 742 p., illus., tables, 1967; originally published 1962.

This textbook written for the nonscience major in college achieves a high degree of integration of the physical science of astronomy, physics, chemistry, and geology.

The 48 chapters are divided into eight parts which are: the solar system, force and motion, molecules and energy, the electrical nature of matter, structure of matter, atomic structure and chemical combination, matter and energy in the study of the Earth, and energy within the nuclei.—LLP

02672 **Borg, I. Y.** Optical properties and cell parameters in the glaucophane–riebeckite series: Contr. Mineralogy and Petrology, v. 15, no. 1, p. 67–92, illus., tables, 1967.

A complete set of new optical and X-ray data is given for 11 alkali amphiboles. Nine new wet chemical analyses are reported. Using additional selected data from the literature, variation in refractive indices, extinction angles, optic angles, density, lattice constants and cell volume are expressed graphically as a function of composition in the glaucophane–riebeckie and magnesioriebeckite–ferroglaucophane series. Four orientations of the optical indicatrix within the structure are described and shown to be characteristic of the chemical species glaucophane, crossite, magnesioriebeckite, riebeckite, and riebeckite–arfvedsonite. Optical properties of the pure end members are extrapolated, and X-ray parameters referred to the C 2/m space group. These agree well with comparable measurements on synthetic counterparts.—*from* Author's abstract

02491 **Bott, M. H. P.; Scott, B. Smithson.** Gravity investigations of subsurface shape and mass distributions of granite batholiths: Geol. Soc. America Bull., v. 78, no. 7, p. 859–877, illus., table, 1967.

Most postkinematic granite plutons show negative gravity anomalies that suggest the plutons extend to depths of about 10 km and that mass has been removed during emplacement. Observed gravity profiles are compared with computed profiles across many mass distribution patterns. Interpretation of the comparisons indicates that the plutons are most likely emplaced primarily by stoping, provided that the displaced material: (1) has sunk to great depth, or (2) was dispersed during emplacement, or (3) was negated by a low-density root beneath the granites.—RGY

02779 **Bott, M. H. P.; Johnson, G. A. L.** The controlling mechanism of Carboniferous cyclic sedimentation [abs.]: Geol. Soc. London Proc. 1965–66, no. 1635, p. 163–164; discussions, p. 164–168, 1967.

02808 **Boucot, A. J.; Cumming, L. M.; Jaeger, H.** Contributions to the age of the Gaspé Sandstone and Gaspé Limestone: Canada Geol. Survey Paper 67–25, 27 p., illus., tables, 1967.

Restudy of fauna of the lower Gaspé Sandstone Group shows that at least the lower one-fifth is Lower Devonian. In eastern Gaspé, the York River Formation is of *Etymothyris* zone age; in western Gaspé, the 'Heppel' Formation is of *Etymothyris* and *Amphigenia* zone age. The brachiopod genera *Rhenorensselaeria, Prionothyris, and Globithyris* are present. A gastropod from the Gaspé Sandstone, *Nylanderina* n.gen., occurs in the Lower Devonian Tomhegan Formation, and in the Lower Devonian beds near Highland Mills, N. Y. The Gaspé Sandstone Group is conformably underlain by the Gaspé Limestone Group; the upper part of the limestone is also Lower Devonian, and the occurrence of *Monograptus aequabilis* suggests that the base lies near the Silurian boundary.—*from* Authors' abstract

02885 **Boucot, A. J.; Johnson, J. G.** Silurian and Upper Ordovician atrypids of the genera *Plectatrypa* and *Spirigerina*: Norsk Geol. Tidsskr., v. 47, no. 1, p. 79–102, illus., 1967.

Nomenclatural history of the brachiopod genera *Plectatrypa and Spirigerina* is traced; species and distribution are listed. The earliest progenitors of *Spirigerina marginalis*, which range from Upper Ordovician into Lower Llandovery, are separated as a new subgenus, *Spirigerina (Eospirigerina)*, based on *Atrypa praemarginalis* Savage in Lower Llandovery of mid-North America and Gaspé. True *Plectatrypa* is unknown below the Lower Llandovery; previously cited Ordovician species should be included in *Eospirigerina*. *Plectatrypa* is regarded as an early offshoot of Atrypinae, off the main line of evolution that resulted in *Atrypa*

s.s., and then little differentiated from *Eospirigerina*, earliest known member of Carinatininae.—*from* Authors' abstract

Boudette, E. L. *See* Espenshade, G. H. 02763

Bowen, Roger W. *See* Jackson, Everett D. 02465

Bowen, Vaughan T. *See* vanAndel, Tjeerd H. 02840

02559 **Bowman, James Floyd, 2d.** Petrology of the Pensauken Formation [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3988B, 1967.

02726 **Boyd, F. R.; Bell, P. M.; England, J. L.; Gilbert, M. C.** Pressure measurement in single-stage apparatus: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 410–414, illus., table, 1967.

Present results change considerably the authors' earlier view that the "friction" was predominantly in the shear strength of the pressure media. They suggest rather that at high temperatures piston-cylinder friction is the principal source of error in pressure measurement. Nevertheless, this error will normally not exceed ±5 percent, and if special effort is made, may be reduced to ±0.5 percent. No transition at high temperature is now known with more accuracy than the Bil⇆Bill transition at room temperature, but the quartz⇆coesite transition has much to recommend it as a potential calibration point. In this study the authors have concentrated on quartz⇆coesite at 1,400°C (Pt/Pt10Rh), a temperature that is representative of much of their work. Results of experiments are described.—MST

Bradley, Edward. *See* Eddy, J. E. 02472

02818 **Brady, W. B.; Wilson, D. W. R.** What Rainbow reefs may look like [abs.]: Oilweek, v. 18, no. 28, p. 21, 24, 1967.

02904 **Branson, Carl C.** Protest against names for trace fossils [Discussion of papers by W. Häntschel, 1962, 1965, and by A. H. Müller, 1966]: Oklahoma Geology Notes, v. 27, no. 7, p. 151, 1967.

Proliferation of binomials for trace fossils is especially apparent in the careful and thorough compilations of Häntschel (1962, Treatise on invertebrate paleontology, Pt. W, p. 177–245; 1965, Fossilium Catalogus, [Pt.] 1, Pars 108). The futility of applying names to many of these objects is shown by the ridiculous use of the name *Zoophycos* for Ordovician to Miocene trace fossils, considered by this author to be in most cases inorganic sedimentary structures. *Taenidium? maeanriformis* Müller (1966, Geologie, v. 15, p. 712–725), from Saxony, clearly is a synonym of *Scalarituba missouriensis* (Weller, 1899). *Mixoteichichnus coniungus* is a feeding burrow from the Lower Muschelkalk (Triassic) and does not deserve a name.—GDC

02691 **Brecke, E. A.** Sulfide and sulfur occurrences of the Illinois-Kentucky fluorspar district: Econ. Geology, v. 62, no. 3, p. 376–389, illus., 1967.

Factors that may have influenced the nature and sites of sulfide deposition include carbonate host rock, sulfur from bituminous residues, favorable structure, and temperature.—WSW

02945 **Breiner, Sheldon; Kovach, Robert L.** Local geomagnetic events associated with displacements on the San Andreas fault: Science, v. 158, no. 3797, p. 116–118, illus., tables, 1967.

The piezomagnetic properties of rock suggest that a change in subsurface stress will manifest itself as a change in the magnetic susceptibility and remanent magnetization and hence the local geomagnetic field. A differential array of magnetometers has been operating since late 1965 on the San Andreas fault in the search for piezomagnetic signals under conditions involving active fault stress. Local changes in the geomagnetic field have been observed near Hollister, Calif., some tens of hours preceding the onset of abrupt creep displacement on the San Andreas fault.—Authors' abstract

02696 **Brett, Robin; Kullerud, G.** The Fe–Pb–S system: Econ. Geology, v. 62, no. 3, p. 354–369, illus., tables, 1967.

The phase relations in the ternary system Fe–Pb–S were determined by quenching and differential thermal analysis experiments in rigid silica-glass tubes. An invariant point involving galena, pyrite, sulfide liquid, liquid sulfur, and vapor occurs at 716°C. The ternary liquid at this temperature is situated slightly on the sulfur side of the PbS–FeS_2 join. At 719°C tie lines between galena and pyrite are replaced by sulfide liquid–pyrrhotite tie lines in an invariant reaction involving vapor. The sulfide liquid field expands rapidly and intersects the PbS–FeS_2 join at 723°C. At 848°C the ternary liquid field intersects the FeS–PbS join. Results demonstrate that mixtures of galena and pyrite can crystallize directly from a liquid at 716°C. Additional components may make melting of pyrite-galena ores below 700°C possible when exposed to thermal metamorphism.—*from* Authors' abstract

02907 **Brett, Robin; Henderson, E. P.** The occurrence and origin of lamellar troilite in iron meteorites: Geochim. et Cosmochim. Acta, v. 31, no. 5, p. 721–730, illus., tables, 1967.

A number of iron meteorites contain elongated inclusions consisting predominantly of troilite. Two types exist: The first, up to 6 cm long and 0.2 mm wide, contains troilite with subordinate daubreelite and is commonly rimmed by schreibersite and swathing kamacite; the second, up to 2 cm long and 3 mm wide, consists largely of troilite with daubreelite and rare graphite or silicate grains. Both types formed from a residual sulfide melt after solidification of the nickel-iron metal; swathing kamacite formed by nucleation at the troilite–metal interface during formation of the Widmanstätten texture. Meteorites containing troilite inclusions of the second type appear to have cooled more rapidly than most iron meteorites.—DBV

Brobst, D. A. *See* Shawe, D. R. 02433

02810 **Bromfield, Calvin S.** Geology of the Mount Wilson quadrangle, western San Juan Mountains, Colorado: U.S. Geol. Survey Bull. 1227, 100 p., illus., tables, geol. map, 1967.

A bedded sequence of generally flat-lying sedimentary and volcanic rocks which aggregate 5,000 feet in thickness and range in age from Late Triassic to middle Tertiary has been intruded by laccoliths and composite stocks ranging in composition from microgranogabbro to adamellite, by numerous dikes and sills of intermediate composition, and by several lamprophyre dikes. The Wilson Peak stock, the largest in the quadrangle, has not significantly deformed the flat-lying country rocks, and has probably completed its emplacement by a process in which piecemeal stoping was important. Silver, lead, zinc, and gold valued at about 3 million dollars have been mined from veins associated with the stocks.—CSB

Brooks, Robert R. *See* Presley, Bob J. 02841

Brown, D. D. *See* George, P. T. 02901

03030 **Brown, Donald M.** Regional oil possibilities of the Abilene–Nemaha Anticline area, northeast Kansas [abs.]: Shale Shaker, v. 18, no. 1, p. 16, 1967.

02582 **Brown, J. S.** Precambrian Grenville or Paleozoic quartzite in the Dekalb area in northern New York—Discussion [of paper by R. O. Bloomer, 1965]: Geol. Soc. America Bull., v. 78, no. 7, p. 921–930, illus., tables, 1967.

Evidence is presented to support the writer's belief that the small areas of quartzite in the Dekalb area are Paleozoic Potsdam Sandstone rather than Precambrian Grenville Series as interpreted by Bloomer (ibid., v. 76, no. 9, p. 1015–1026, 1965).—AG

02888 **Brown, R. J. E.** Permafrost in Canada: Canada Geol. Survey Map 1246A (1st edition), scale 1:7,603,200, text, 1967.

The criterion for division between continuous and discontinuous zones of permafrost is the −5°C isotherm of mean annual ground temperature measured just below the seasonal variation zone. In the Canadian Shield permafrost occurs in better drained portions of bogs and peatlands in the southern fringe; northward it increases in extent and is in bedrock in the continuous zone. The Hudson Bay Lowland is within the discontinuous zone except for a narrow strip along the Hudson Bay coast. Only the extreme northern portion of the Interior Plains lies in the continuous zone; it appears that permafrost does not exist beneath the Mackenzie River or water bodies in its delta. In the Cordillera distribution varies with altitude and latitude. The Arctic Archipelago lies entirely within the continuous zone except possibly the southeast tip of Baffin Island.—MCM

02463 **Bryant, Bruce.** The occurrence of green iron-rich muscovite and oxidation during regional metamorphism in the Grandfather Mountain window, northwestern North Carolina, *in* Geological Survey research 1967. Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C10-C16, illus., tables, 1967.

Assemblages containing (1) magnetite, magnetite and hematite, or hematite, (2) variable and generally high Fe_2O_3/FeO ratios, and (3) green muscovite rich in ferric iron in various rock types in progressively and retrogressively metamorphosed rocks suggest that the rocks in the Grandfather Mountain window were open to oxygen during metamorphism. Metamorphism apparently took place under conditions of high shearing stress, low temperature, and high P_{water}.—Author's abstract

Bufe, Charles. *See* Carder, Dean S. 02997

Burbank, Lawrence. *See* Péwé, Troy L. 02811

02601 **Burger, Henry Robert, 3d.** Structure, petrology, and economic geology of the Sheridan district, Madison County, Montana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3561B, 1967.

02636 **Burnham, Charles W.** Ferrosilite: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 285-290, illus., tables, 1967.

Crystal chemistry of the three polymorphs of ferrosilite, $FeSiO_3$, bears an important relation to the behavior of natural pyroxenes in common rock-forming chemical systems. Burnham reports that refinements of the structures of clinoferrosilite and orthoferrosilite are now nearly complete. Although anisotropic atomic thermal models are not yet available, refinements have thus far converged to unweighted R values of 0.043 (CFs, 659 observations) and 0.051 (OFs, 501 observations). Subsequent parameter shifts are expected to be inconsequential. The results based on current bond distances are discussed.—MST

Burnham, Charles W. *See* Güven, Necip. 02637

Burnham, Charles W. *See* Skinner, C. 02648

Burri, M. *See* Ayrton, S. N. 02803

02695 **Buseck, Peter R.** Contact metasomatism and ore deposition, Tem Piute, Nevada: Econ. Geology, v. 62, no. 3, p. 331-353, illus., tables, 1967.

A banded garnet-pyroxene skarn zone separates barren limestone and hornfels from unmineralized quartz monzonite. Pyrrhotite, marcasite, magnetite, and molybdenite occur on the quartz monzonite side and sphalerite (with exsolved pyrrhotite or chalcopyrite), galena, bismuthinite, bismuth, and bismuth sulfosalts on the limestone side. Other metallic minerals include pyrite, chalcopyrite, scheelite, hematite, galenobismutite, and cosalite. The composition of pyrrhotite annealed to monoclinic form suggests temperatures in the range 455°-500°C. Upper limit of the pyrite-bismuth assemblage is about 235°C, indicating a steep thermal gradient across the skarn zone. Ilvaite is a common gangue mineral of the inner, hotter portion, and fluorite is common in the outer part.—WSW

02886 **Bushnell, Kent.** Geology of the Rowland quadrangle, Elko County, Nevada: Nevada Bur. Mines Bull. 67, 38 p., illus., tables, geol. map, 1967.

In the Rowland quadrangle, pre-Cenozoic argillaceous formations of the western facies are in thrust contact with the following argillaceous, calcareous, and quartzitic formations of the eastern facies: Tennessee Mountain Formation, Prospect Mountain(?) Quartzite, and some unnamed formations. The Upper Pennsylvanian-Lower Permian Sunflower and Diamond A Formations lie unconformably on older rocks. Two granitic stocks were emplaced during Late Cretaceous, and the Bieroth Andesite, Jarbridge Rhyolite, and Idavada Volcanics during middle and late Tertiary. Carboniferous, late Mesozoic to early Cenozoic (Trail Gulch fault formed), and a mid-Cenozoic orogenies are recognized. The most important mineral deposits are hydrothermal fissure and shear zone deposits of silver and lead ores.—LLP

02823 **Campbell, F. H. A.; Schenk, P. E.** Paleocurrent and basin analysis of the Meguma Group, Nova Scotia: Maritime Sediments, v. 3, no. 1, p. 27-30, illus., 1967.

The lower Paleozoic Meguma Group comprising the basal Goldenville Formation, at least 18,000 feet thick, and conformably overlying Halifax Formation, at least 12,000 feet thick, underlies about one-third of the mainland. A regional, sedimentological-stratigraphic study was begun in 1966. A three-mile grid system was placed over the outcrop, and at the intersections of grid lines, the closest outcrop was examined in detail using a check list. Paleocurrent pattern along the southeast coast indicates longitudinal transport, with the source to the southwest. In general, the Group has a eugeosynclinal flysch aspect. Several specimens of the enigmatic *Astropolithon hindii*, arenite cones, were found.—ESL

03015 **Campbell, R. L., Jr.** Stratigraphic applications of dipmeter data in the Mid-Continent [abs.]: Shale Shaker, v. 18, no. 1, p. 12, 1967.

02902 **Canada Geological Survey.** Aeromagnetic map, Sheet 27 C/4, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4772, scale 1:63,360, 1967.

02997 **Carder, Dean S.; Tocher, Don; Bufe, Charles; Stewart, S. W.; Eisler, Joseph; Berg, Eduard.** Seismic wave arrivals from Longshot, 0° to 27°: Seismol. Soc. America Bull., v. 57, no. 4, p. 573-590, illus., tables, 1967.

Arrivals from Longshot underground nuclear explosion on Amchitka Island were recorded at 27 locations in Alaska and 2 in Yukon at distances between 2.6° and 26.6°. Upper mantle traveltimes to $\Delta = 11°$ can be represented by $t = \Delta(km)/7.85 + 4.9 \pm 0.5$. Depth to the M-discontinuity beneath the Aleutians is estimated at 22-26 km. In the range $\Delta = 6°-16°$, recognition of initial P may be a function of the signal-to-noise ratio; from 13°-27°, traveltimes average 1.5-4.0 sec earlier than J-B times, with a steep gradient from 'early' in central and northern Alaska to an average of 2 sec 'more early' in eastern. PcP arrivals, recognized at $\Delta \geq 15.5°$, are parallel to but 2-4 sec earlier than J-B times. PcP was not anomalously early at Kodiak as was P. P-wave amplitude maximums to Bering Sea stations were an order less than at like distances on the Peninsula.—DBV

02592 **Carey, Kevin L.** The underside of river ice, St. Croix River, Wisconsin, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C195-C199, illus., table, 1967.

Ripplelike and dunelike features have been found during a second winter on the underside of the ice cover on the St. Croix River, Wis. Profiles of the features and measurements of ablation and accretion show that the features began to form when the underside of the ice was accreting, and continued their development during ablation. The Belokon-Sabaneev formula, . . ., satisfactorily shows the relationship between the roughness coefficients for the ice, the bed, and the total channel. Calculations of the roughness coefficient for the underside of the ice range from 0.0039 to 0.0142, except for one calculation which indicates no retardation of the flow by the ice cover. This anomaly is believed to be caused by an incorrect estimate of the effective size of the roughness projections of the bed. Caution is therefore

given that the computed (published) values of the ice-roughness parameters are slightly smaller than actual.—Author's abstract

02547 **Carlson, H. D.** Shaw township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 343, scale 1 in. to 1/4 mi., revised 1967; originally published 1966.

02444 **Carmichael, I. S. E.; Nicholls, J.** Iron-titanium oxides and oxygen fugacities in volcanic rocks: Jour. Geophys. Research, v. 72, no. 18, p. 4665–4687, illus., tables, 1967.

It is shown that in silicate liquids the ferric-ferrous equilibrium is controlled by temperature, oxygen fugacity, *and* the composition of the liquid, particularly its alkali content. Thus the oxygen geobarometer of Buddington and Lindsley (1964) will have to be calibrated, especially for alkali-rich volcanics. Oxygen fugacity and crystallization temperature for basaltic liquids are used to predict the composition of their coexisting oxide minerals; basalts with Curie temperatures significantly above about 200°C are considered to have been subsequently oxidized. Thermoremanent magnetization can only be mineralogically demonstrated in basaltic rocks that contain an orthorhombic oxide phase or its breakdown products.—DBV

02664 **Carmichael, Ian S. E.** The mineralogy and petrology of the volcanic rocks from the Leucite Hills, Wyoming: Contr. Mineralogy and Petrology, v. 15, no. 1, p. 24–66, illus., tables, 1967.

Electron-probe analyses of high-K volcanic wyomingite, orendite and madupite from the Leucite Hills show non-stoichiometric leucite as predicted by Cross (1897); the only feldspar found was iron-sanidine. Coexisting phlogopite, diopside, and olivine, and the groundmass amphibole are all highly magnesian. Accessory priderite and wadeite were analyzed together with ubiquitous apatite and perovskite, both containing abundant rare earths. Excess potassium may account for absence of iron-titanium in the orendites and wyomingites and for the unusual minerals. Experimental melting range, comparable to that of magnesian basalts, precludes a crustal origin. Sialic contamination is not evident, but madupite could have been produced by high-pressure fractionation of a liquid derived from mantle material.—GDC

02967 **Carozzi, Albert V.; Textoris, Daniel A.** Paleozoic carbonate microfacies of the Eastern Stable Interior (U.S.A.): Leiden, Netherlands, E. J. Brill (Internat. Sed. Petrog. Ser., V. 11), 41 p., illus., 1967.

This area from the Transcontinental Arch and Canadian Shield southeast to the Appalachian geosyncline accumulated shallow marine shelf deposits during the entire Paleozoic Era. The sedimentary thickness varies from nothing up to 14,000 feet in the Michigan Basin, increasing from west to east with only gentle regional dips; the Canadian Shield, and the Ozark and Wisconsin Domes were sources. Because of limited petrographic research, only a few areas and a small number of stratigraphic units (omitting the Cambrian) and a selected series of microfacies can be represented in this review. The text with generalized geologic and paleogeographic maps and columnar sections sets the frame of reference for the 200 photomicrographs of thin sections. Each has a detailed legend of petrography, stratigraphic age, location, and environmental interpretation.—GDC

02946 **Carr, Donald D.; Webb, William M.** Sand and gravel exploration by thermal sensing of soil, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 32–38, illus., 1967.

The relation of near-surface soil temperatures to underlying kame, esker, and valley-train terrace deposits in central Indiana has been examined. These data and results of an earlier study indicate that coarse materials such as sand and gravel can be differentiated from adjacent clays and silts by relative magnitude of diurnal soil temperature change. Measured at a depth of 30 cm, the change was found to be greater in soils above sands and gravels of kame, esker, and valley-train deposits than above clay and silt. An inverse relationship above the outwash plain appears

to reflect variation in soil moisture due to position of the ground-water table. The use of thermal sensing of near-surface soils with airborne infrared detectors to prospect for sands and gravels is particularly attractive to cover large areas.—GDC

02560 **Cavender, Wayne Sherrell.** Integrated mineral exploration in the Osgood Mountains, Humboldt County, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3988B-3989B, 1967.

02979 **Chamberlin, W. P.** Importance of petrographic analysis and special tests not usually required in judging quality of concrete sand—Discussion [of paper by R. E. Davis, R. C. Mielenz, and M. Polivka, 1967]: Jour. Materials, v. 2, no. 3, p. 482-483, 1967.

Chamberlin's thesis, that physical and other properties of many natural sands have a high degree of mutual correlation, is supported by data gathered by Davis and others (ibid., p. 461-486). In addition to the excellent correlation between absorption and results of attrition tests shown in California sands tested by Tuthill and Adams (ibid., p. 480-482), similar correlation is made in sands from New York with elasticity and sphericity, and in sands from New York and Maine by earlier studies of absorption and magnesium sulfate loss. It is suggested for highway engineers that one characteristic may be a suitable index of many, and worth a cooperative study under ASTM sponsorship.—GDC

02577 **Chao, Tze.** Sulfatization of alumina with gaseous sulfur trioxide and its kinetics [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 4049B, 1967.

Chapman, Carleton A. *See* Hussey, Arthur M. 02918

02860 **Charm, Walter B.** Freeze drying as a rapid method of disaggregating silts and clays for dry particle size analysis: Jour. Sed. Petrology, v. 37, no. 3, p. 970-971, 1967.

Freeze drying fine sediments is an effective method of transforming wet sediment into a dry powder for further study.—HAT

02735 **Chayes, F.** Statistical petrography: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 372-379, table, 1967.

Quantitative descriptive petrography is frequently concerned with correlations between ratios whose numerators and denominators are linear combinations of these proportions. Chayes suggests a procedure which is suitable if the theoretical underlying open variables are uncorrelated, and leads directly to an approximate derivation of the closure effect as a form of ratio correlation; it is easily extended to cover correlation between ratios formed of linear combinations of proportions. For the closure effect itself the approximations are identical with exact results where these are known; when the ratios are linear combinations of proportions, the quality of the approximation is not known at present.—MST

02851 **Cheatham, J. B., Jr.** Strain hardening of a porous limestone: Soc. Petroleum Engineers Jour., v. 7, no. 3, p. 229-234, illus., 1967.

Probing tests of the limit surfaces have been performed on Cordova Cream limestone to provide data for extending plasticity theory to cover situations in which consolidation and strain hardening are present. Test results indicate that this highly porous limestone undergoes a permanent volume decrease when it is subjected to hydrostatic pressures in excess of 3,500 psi. If a sample is subjected to a consolidation pressure of 5,000 psi before testing at 1,500 psi, the yield strength is raised to 2,300 psi. Thus, both consolidation and strain hardening are important considerations in describing the mechanical behavior of this limestone. Tests using different orientations of the core axis indicate that the rock is isotropic. Portions of initial and subsequent limit surfaces are determined for samples loaded either perpendicular or parallel to the bedding planes.—*from* Author's abstract

02716 **Cheney, E. S.; Jensen, Mead Leroy.** Corrections to carbon isotopic data of Gulf Coast salt-dome cap rock [reply to 1967 comments by J. N. Weber and P. Deines on 1965 paper]: Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1345–1346, tables, 1967.

Corrections to the carbon isotopic data [ibid., v. 29, no. 12, p. 1331–1346, 1965] indicate that the Gulf Coast salt-dome cap rock has a mean of −36.2 per mil and a sample standard deviation of 6.2 per mil.—Authors' abstract

Cheng, M. H. *See* Blanchard, R. L. 02448

03021 **Chenoweth, P. A.** Early Paleozoic overlap, southern Mid-Continent [abs.]: Shale Shaker, v. 18, no. 1, p. 14, 1967.

02561 **Cherry, John Anthony.** Geology of the Yorkton area, Saskatchewan [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3989B, 1967.

02562 **Chiburis, Edward Frank.** Crustal structures in the Pacific Northwest states from phase-velocity dispersion of seismic surfave waves [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3989B–3990B, 1967.

Chinnery, Michael A. *See* Toksöz, M. Nafi. 02503

03003 **Chopra, Anil K.** Reservoir-dam interaction during earthquakes: Seismol. Soc. America Bull., v. 57, no. 4, p. 675–687, illus., table, 1967.

The importance of the interaction between dam and reservoir in determining water pressure on dams during earthquakes is analyzed. The analysis is approximate, and is aimed at exploring the problem. The earthquake acceleration is first modeled as a stationary gaussian white noise process. For this excitation, certain qualitative conclusions concerning importance of interaction effects are derived. Hydrodynamic responses of typical systems subjected to the El Centro (1940) earthquake are then determined to confirm these conclusions. It is concluded that the interaction between reservoir and dam has a significant influence on the hydrodynamic responses during earthquakes.—DBV

02477 **Christ, C. L.; Hostetler, Paul B.** Activity coefficients from emf measurements, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C106–C109, illus., 1967.

Mean activity coefficients, $\gamma\pm$, are readily determinable from measurements of potential on emf cells employing cation-sensitive electrodes, and having no liquid junction. Accurate results are obtained only when successive measurements are made on solutions having relatively small incremental differences in concentration. Recognition of this fact leads to a new graphical method for treating the experimental data, which is superior, both in principle and in practice, to previous methods.—Authors' abstract

Christie, K. W. *See* Larochelle, A. 02923

03031 **Clair, Joseph R.; Volk, Richard W.** Pre-Permian Paleozoics of the Las Animas Arch—A new oil province [abs.]: Shale Shaker, v. 18, no. 1, p. 16, 1967.

02667 **Clarke, D. B.** Tertiary basalts from Baffin Island and West Greenland [summ.]: Geol. Soc. London Proc. 1965–66, no. 1637, p. 50–52, discussion, 1967.

02519 **Clarke, H. C.** A fused-quartz Curie-point balance, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 438–439, illus., 1967.

In this type of beam torsion balance, force exerted by a sample suspended in a magnetic field at one end of the beam is countered by the restoring torque of a torsion fiber and glass weights. The instrument is inexpensive to build and maintain, and measurements can be made either manually or automatically.—LLP

02446 **Cleary, John.** Analysis of the amplitudes of short-period P waves recorded by long range seismic measurements stations in the distance range 30° to 102°: Jour. Geophys. Research, v. 72, no. 18, p. 4705-4712, illus., tables, 1967.

A least-squares program devised by Carpenter et al [1967] has enabled the analysis of P amplitudes at LRSM stations from the same set of earthquake data used by Cleary and Hales [1966] in their study of P times. The variation of amplitude with distance given by this analysis was found to be in substantial agreement with an amplitude-distance curve derived from the Cleary-Hales traveltime curve. Station amplitude terms from the analysis indicate that the recorded amplitudes tend to be lower in mountainous areas than in areas of crustal stability, in conformity with the findings of Jordan et al [1965].—Author's abstract

02916 **Cleveland, George B.** Why landslides?: California Div. Mines and Geology Mineral Inf. Service, v. 20, no. 9, p. 115-117, illus., 1967.

The material in this article, including the maps, was taken from an unpublished manuscript by R. P. Blanc and Cleveland. The question is raised as to whether California's landslide problem can be completely controlled. Large parts of many cities are already built on landslide-prone rocks, and ground-water migration and climate changes cannot be predicted. The fact that the State is in a seismic belt adds a significant dimension to the problem. The concept of the geologic province is involved in a formula necessary to reduce landslides. Geologic and stability sketch maps are included.—ESL

02677 **Clifton, H. Edward.** Solution-collapse and cavity filling in the Windsor Group, Nova Scotia, Canada: Geol. Soc. America Bull., v. 78, no. 7, p. 819-831, illus., tables, 1967.

Limestone breccia in central Nova Scotia, heretofore considered sedimentary breccia, is interpreted as a deposit formed by collapse and disintegration following solution. In outcrop the breccia disconformably overlies the basal part of the Mississippian Windsor Group but is absent at depth. Formation of the breccia postdates the late Paleozoic regional deformation. It was derived in part from Triassic rocks indicating that it formed long after deposition of the Windsor Group.—JGV

02973 **Coash, John R.** Geology of the Mount Velma quadrangle, Elko County, Nevada: Nevada Bur. Mines Bull. 68, 20 p., illus., tables, geol. map, 1967.

Rocks exposed in the Mount Velma quadrangle are chiefly Cenozoic volcanic rocks; several sedimentary formations of the upper Paleozoic "overlap assemblage" crop out in north-central Nevada. Volcanic and sedimentary rocks lie between these in the south-central part of the quadrangle, and, in the northern part, the "overlap assemblage" lies upon probable lower Paleozoic sediments. Late Cretaceous(?) intrusions were followed by uplift and erosion. Extensive coarse gravels underlie volcanic rocks intruded during at least two periods in middle or late Cenozoic. Folding of volcanic rocks in the north was accompanied or followed by normal faulting. A prominent set of northwest-trending normal faults with a strike-slip component cuts the area. Partially consolidated gravels in terraces which show effects of faulting and tilting are now being cut by streams.—*from* Author's abstract

02701 **Coffman, J. S.; Service, A. L.** An evaluation of the western phosphate industry and its resources (in five parts)—[Pt.] 4, Wyoming and Utah: U.S. Bur. Mines Rept. Inv. 6934, 158 p., illus., tables, 1967.

Potentially economic reserves of +10 percent P_2O_5 grade phosphate rock aggregate more than 700 million tons in Wyoming and 2.5 billion tons in Utah. An additional three billion tons occur in less accessible deposits within remote parts of western Wyoming. The phosphate is found in rocks of the Phosphoria Formation in a number of different structural settings. The Phosphoria in the western areas is generally highly folded, steeply dipping, and complexly faulted, in contrast to the eastern areas, where it is comparatively horizontal and little faulted. The phosphate-bearing beds of the western areas are generally thicker and higher grade than the eastern areas. The geology, phosphate resources, economic factors, and geographic situation of a number of localities are described.—KFF

02426 **Cohen, Lewis H.; Klement, William, Jr.** High-low quartz inversion—Determination to 35 kilobars: Jour. Geophys. Research, v. 72, no. 16, p. 4245–4251, illus., 1967.

The high-low quartz inversion has been determined over the range 6 to 35 kb by means of differential thermal analysis in piston-cylinder apparatus, with chromel-alumel, Platinel II, and Pt versus Pt+10 percent Rh thermocouples. The transition temperature initially rises at the rate of about 26 deg kb^{-1}; the curvature, $-d^2T/dp^2$, is less than about 0.4 deg kb^{-2}, in contrast with the reports of Gibson and of Yoder for the inversion at lower pressures. Comparison with selected data for the quartz-coesite transition suggests an intersection with the high-low quartz inversion near about 1,400°C and about 37 kb. The several thermodynamic constraints involved if the inversion is first order (and this is not established at present) are discussed in the context of the present results.—Authors' abstract

Coleman, R. G. *See* Blake, M. C., Jr. 02462

02419 **Colinvaux, Paul A.** Quaternary vegetational history of arctic Alaska, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 207–231, illus., tables, 1967.

The lowlands of arctic Alaska and the Bering Sea islands were never completely glaciated, so pollen records of ancient Beringian plant communities have survived. Tundra diagrams record only a few broadly defined taxa of dwarf birch, grass, and sedge; Livingstone's three-zone sequence in the Brooks Range is described. Other pollen records compared with this include one from Ogotoruk Creek, a 25,000-yr record from the Barrow area, two from Seward Peninsula, one of late Wisconsin age from Kotzebue Sound, a core of sediments from a St. Lawrence Island lake, three spectra from Goodnews Bay, and lake and bog cores from the Pribilof Islands. An explanation for ancient *Artemisia* maxima would add to understanding of land-bridge vegetation. Fossil logs and beaver dams found on Seward and Baldwin Peninsulas suggest a westward extension of the tree line in response to postglacial warming.—ESL

02602 **Collinson, James Waller.** Permian and Triassic biostratigraphy of the Medicine Range, Elko County, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3561B—3562B, 1967.

Colombo, Umberto. *See* Nagy, Bartholemew. 02772

03004 **Cook, Kenneth L.; Smith, Robert B.** Seismicity in Utah, 1850 through June 1965: Seismol. Soc. America Bull., v. 57, no. 4, p. 689–718, illus., tables, 1967.

Of the 609 or more earthquakes which occurred in Utah in the period 1850–June 1965 at least 38 were damaging. Pertinent data are listed, and a map of epicenters is given. Epicenters were determined using a slightly modified Geiger's method programmed for an IBM 7044 digital computer; the program used unpublished traveltime curves (Atwell, 1967) computed from the crustal model of Berg and others (1960) for the Utah region, and included depth-of-focus data at 10-km-depth intervals from 0 to 60 km. Recent earthquake activity has been in the Ephraim, Cache Valley, and Levan areas, and swarm activity in the Lehman Caves area. In 1962–64 Utah averaged about 60 earthquakes per year for which epicenters were determined.—DBV

02935 **Cordova, Simon.** Castaic Junction oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1966, v. 52, no. 2, pt. 2, p. 55–65, illus., tables, 1967.

Formations penetrated in the Castaic Junction field range in age from Recent to upper Miocene; except for alluvium and terrace deposits, all rocks exposed at the surface are in the Saugus Formation. The field is on the Del Valle anticline, a regional structure in the eastern portion of the Ventura sedimentary basin; in this area the anticline has a regional east-southeasterly trend and plunge. The producing zones are all in the Modelo Formation (upper Miocene): the 10 zone, depth 8,400 feet, productive only in the eastern portion of the Main fault block; the 15 zone,

depth 9,500 feet, productive only at the crest of the anticline of the Main fault block; and the 21 zone, productive in all three of the principal fault blocks, at depths of 10,400 feet in the Main block, 9,600 feet in the Del Valle block, and 11,800 feet in the North block.—MCM

Corliss, John B. *See* vanAndel, Tjeerd H. 02840

02759 **Cornish, Earl.** Ground water: Colorado School Mines Mineral Industries Bull., v. 10, no. 4, 26 p., illus., tables, 1967.

The general significance and future potential of ground water are discussed including what ground water is, where it can be found, and some of the legal aspects involved in its efficient development. Also included is a map of Colorado showing the total drainage system and areas where extensive ground-water studies have been made by the Federal Government. Federal bulletins containing data on these studies are listed in the bibliography.—LLP

Cox, A. *See* Doell, R. R. 02521

Cox, Allan. *See* Doell, Richard R. 02524

Cox, Allan. *See* Doell, Richard R. 02531

Cox, Allan. *See* Doell, Richard R. 02533

Cox, Allan. *See* Doell, Richard R. 02535

Cox, Allan. *See* Doell, Richard R. 02536

Cox, Allan. *See* Doell, Richard R. 02537

02540 **Cox, Allan; Doell, Richard R.** Measurement of high-coercivity magnetic anisotropy, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 477–482, illus., tables, 1967.

A method of measuring magnetic anisotropy as a function of coercive force in order to assess the reliability of paleomagnetic results is described. Although the experiments involved are more laborious than other methods, results are more definitive and no special apparatus is required.—LLP

02633 **Craig, J. R.; Kullerud, G.** The Cu–Pb–S system: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 342–344, illus., 1967.

Investigation of the Cu–Pb–S system has been started, principally to provide necessary data for the geologically important quaternary systems Cu–Fe–Pb–S, Cu–Pb–Zn–S, and As–Cu–Pb–S systems. Ternary phase relations have been investigated between 600°C and 400°C using silica-tube experiments and differential thermal analysis. Phase relations in the Cu–Pb–S system parallel somewhat those in the Fe–Pb–S system, with the important exception of the appearance of a ternary sulfide liquid at much lower temperatures.—MST

02634 **Craig, J. R.; Kullerud, G.** The Cu–Fe–Pb–S system: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 344–352, illus., 1967.

Investigation of the complex quaternary Cu–Fe–Pb–S system, directed toward the determination of the stability limits of stable sulfide assemblages, has been initiated with silica-tube experiments and differential thermal analysis. An isothermal diagram of the system at 450°C is presented. Phase relations between 450° and 800°C have been investigated. The geological implications are discussed.—MST

02643 **Craig, J. R.** Pentlandite composition: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 329, 1967.

A series of experiments were undertaken to resolve the question of pentlandite composition. Synthesis of homogeneous pentlandite of stoichiometric ($Fe_{4.5}Ni_{4.5}S_8$) composition was not successful, because several percent pyrrhotite solid solution was always present. The experimental data point to a composition at 600°C which is sulfur deficient with respect to the metal/sulfur ratio of 9/8, and which at an Fe/Ni ratio of 1 corresponds to $Fe_{4.5}Ni_{4.5}S_{7.8\pm0.1}$.—MST

02644 **Craig, J. R.** Appearance of phases during cooling of pyrrhotite-rich Ni-Cu ores: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 335-336, 1967.

Several experiments were made using a bulk sample with a composition similar to typical Ni-Cu sulfide ores, especially of the Strathcona deposit at Sudbury, Ontario. The experiments showed the stable phases appearing at temperatures gradually decreasing from near liquidus to below 300°C. The results of these experiments when applied to the footwall ores of the Strathcona deposit indicate that if the ores were introduced as a homogeneous sulfide-oxide magma and crystallized under equilibrium conditions the ore would have consisted of a pyrrhotite solid solution-magnetite mixture until cooled below 500°C. At about 450°C chalcopyrite would have begun to exsolve from pyrrhotite. Formation of pyrite and pentlandite through decomposition of the Ni-bearing pyrrhotite would have occurred only after the ore mass had cooled below 300°C.—MST

02645 **Craig, J. R.; Kullerud, G.** The Cu-Fe-Ni-S system: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 329-335, illus., 1967.

Phase relations in the Cu-Fe-Ni-S system have been investigated in the temperature range 650°C to 550°C. Considerable data have been massed also regarding liquidus relations and phase relations down to 300°C in portions of the system of geological pertinence. Several phases in this system have considerable ranges of binary, ternary, and quaternary solid solutions. These solid solutions play an important role in the formation of Ni-Cu bearing mineral assemblages. The limits of Cu solid solution in the monosulfide solid solution are not yet precisely known; it is apparent, however, that sufficient Cu will dissolve at 550° to 650°C to account for much if not all of the chalcopyrite observed in Ni-Cu ores.—MST

02646 **Craig, J. R.** Pyrite-pentlandite relations: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 328-329, 1967.

Experiments conducted on the monosulfide solid solution with pyrite and pentlandite as starting materials show homogenization complete at 400°C and at 350°C. It is now possible to place the maximum temperature of equilibrium formation of this mineral pair in the presence of a vapor at less than 300°C, as a result of this and other experiments by Craig. A 300°C temperature limits the possible mechanisms of formation; in particular, it rules out formation through crystallization from a sulfide melt.—MST

02486 **Crandell, Dwight R.** Glaciation at Wallowa Lake, Oregon, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C145-C153, illus., 1967.

The great compound morainal embankments that enclose Wallowa Lake in northeastern Oregon include the deposits of at least four glaciations, of which three may be represented by two or more stades. Differentiation of drift units is largely based on conspicuous differences in depth of oxidation and the relative amount of secondary clay and calcium carbonate in weathering profiles and on the presence or absence of granodiorite boulders on moraines. The two oldest drifts are probably of pre-Sangamon age. The youngest two are correlated with drift formed during the Salmon Springs and Fraser Glaciations of western Washington.—Author's abstract

Crawford, C. B. *See* Raymond, Gerald P. 02746

02785 **Crawford, Norman H.** Digital simulation methods in hydrology, *in* Forest hydrology—Natl. Sci. Found. Advanced Sci. Seminar, University Park, Pa., 1965, Proc.: London and New York, Pergamon Press, p. 761-769, illus., 1967.

Digital simulation could be called aggressive experimentation with mathematical representations; its relationships to physical and analog methods of simulation are explored and its major advantages and limitations in hydrology are discussed. Simulation of any physical system is dependent on the accuracy of the data about the system; digital simulation has a major time advantage, but is not a substitute for the analyst. Current research at Stanford University on digital simulation models of the hydrologic cycle is reviewed and the characteristics of the Stanford Watershed Model are outlined. Its current version has four major parameters, of which three govern infiltration levels and the upper and lower zone storages respectively; the fourth governs the interflow–surface runoff division.—GDC

Cressman, Earle R. *See* Pampeyan, Earl H. 02896

Crosby, E. J. *See* McKee, E. D. 02857

02603 **Crosson, Robert Scott.** Seismic wave radiation from sources moving over a finite distance [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3562B, 1967.

02692 **Cruft, E. F.; Giles, D. L.** Direct-reading emission spectrometry as a geochemical tool: Econ. Geology, v. 62, no. 3, p. 406–411, illus., tables, 1967.

A direct-reading spectrometer has advantages over the conventional photographic method where programs involve several elements, wide sensitivity ranges, and a large number of samples.—WSW

Cumming, L. M. *See* Boucot, A. J. 02808

Currie, K. L. *See* Larochelle, A. 02438

02793 **Currie, K. L.; Shafiqullah, M.** Carbonatite and alkaline igneous rocks in the Brent Crater, Ontario: Nature, v. 215, no. 5102, p. 725–726, tables, 1967.

Petrographic observations have hitherto been thought to demonstrate an impact origin for the Brent crater, but the petrochemistry of the rocks strongly suggests that the structure is an alkaline carbonatite complex. The implications drawn from the petrographic data must therefore be reassessed.—DBV

02949 **Cutcliffe, William E.; Dunn, James R.** Evaluation of coarse aggregate for architectural concrete, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 39–44, 1967.

In use of exposed aggregate for architectural concrete, variations of color and texture are critical, so quarrying procedures must be integrated with rock variations to produce desired effects. Extremely high quality aggregate is required because three sides of it are exposed to cyclical temperature extremes, wetting and drying, rapid freezing and thawing, and it must maintain its color and soundness over the lifetime of the structure. Soundness tests in New York are run on relatively homogeneous lithologic thicknesses, with heavy emphasis on the 25-cycle freeze-thaw results. Field criteria are presented to establish quality, stratigraphic continuity, color control, and rock symptoms which might indicate potential problems.—GDC

02903 **Davidson, C. F.; Pereira, J.; Sawkins, F. J.; Taylor, J. H.; Phillips, R.** (and others). Precipitation of lead-zinc ores in carbonate reservoirs as illustrated by Pine Point ore field, Canada [discussion of paper by F. W. Beales and S. A. Jackson (1966)]: Inst. Mining and Metallurgy Trans., v. 76, Sec. B, Bull. 726, p. B130–B136, 1967.

The paper by Beales and Jackson (ibid., v. 75, Bull. 720, p. B278–B285, 1966) was reviewed by L. V. Illing with reported comments questioning why, if concentrated by metalliferous connate waters, sulfide orebodies are not more common in reefs explored for oil and gas. Source of metals and hydraulic mechanism are the debatable subjects. W. M. Tupper's observations on exploration history and geochemical data are reported. Agreeing in general with the author's conclusions, Davidson dwells on evidence of associated evaporite conditions, even in

metamorphic rocks. Pereira points to deposition near original shore-line environment. Sawkins compares connate-water content of metals in relation to source, particularly shales. Taylor notes lack of reference to extent of mineralization around margins of an evaporite basin. Phillips is interested in definition of diagnostic criteria and full range of mineralogy for such deposits.—GDC

Davis, B. T. C. *See* Bell, Peter M. 02661

02736 **Davis, G. L.; Hart, S. R.; Aldrich, L. T.; Krogh, T. E.; Munizaga, Fernando.** Geochronology: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 379–386, illus., 1967.

In this investigation the method of whole-rock rubidium-strontium analysis has been applied to some of the Grenville rocks in Ontario. Analysis of a piece of rock instead of separated mineral samples provides valuable age measurements where the minerals have been affected by postcrystallization metamorphism. The analysis of a number of related whole-rock samples indicates whether a given sample is large enough to represent a closed system. It is concluded that the Sudbury area rocks are older than about 1,500 m.y. and, hence, were formed before the last metamorphism at 930 m.y. Intrusive granites in the region have been dated at about 1,750 m.y.; therefore, a time correlation with these granites is implied rather than the time of the Grenville metamorphism.—MST

02500 **Davis, Margaret B.** Pollen deposition in lakes as measured by sediment traps: Geol. Soc. America Bull., v. 78, no. 7, p. 849–858, illus., tables, 1967.

Suspended sediment traps were used to test pollen sedimentation in three New England lakes. Rates within a lake measured at three different stations were similar but very different for two lakes in near proximity, and counts may vary annually. Differences in rates may reflect differences in pollen input from air or streams or differences in amount of resuspension, mixing, and redeposition.—JJH

02889 **Davis, R. E.; Mielenz, R. C.; Polivka, M.** Importance of petrographic analysis and special tests not usually required in judging quality of concrete sand: Jour. Materials, v. 2, no. 3, p. 461–486, illus., tables, discussion, 1967.

Sand and gravel aggregates from an undeveloped glacial moraine deposit, when properly processed, met ASTM specifications for concrete construction, but high water requirements and rapid stiffening of the concrete resulted from severe degradation of the sand in handling, transporting, and cement mixing. This created a high percentage of fines with unusually large proportion of montmorillonoid clay minerals, a not uncommon problem. The morainal materials originated from weathered volcanic formations in the area of the project. A special attrition test similar to that described herein is recommended, in addition to standard ASTM requirements and petrographic examination of sand from any potential source of concrete aggregates. Discussions by Tuthill and Adams, Chamberlin, and DePuy and others are cited separately.—GDC

02807 **Davis, R. W.** Availability of ground water in the Milburn quadrangle, Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-179, scale 1:24,000, section, text, 1967.

Sufficient supplies of ground water for domestic, public, and industrial needs are available in the area of the Milburn quadrangle, mainly from Eocene sand. One zone is in sand beds that are either above or near the top of clay beds of the shallower deposits, the other zone is in the thick coarser sand below the clay sequence. Water from the Eocene aquifers is of good quality.—MCM

02723 **Davis, Robert E.; Drake, Avery Ala, Jr.; Epstein, Jack B.** Geologic map of the Bangor quadrangle, Pennsylvania-New Jersey: U.S. Geol. Survey Geol. Quad. Map GQ-665, scale 1:24,000, sections, 1967.

02780 **Deer, W. A.** Lawrence Rickard Wager [1904–1965]: Geol. Soc. London Proc. 1965–66, no. 1636, p. 211–213, 1967.

Degens, E. T. *See* Deuser, W. G. 02663

Deines, P. *See* Weber, Jon N. 02727

Delany, A. C. *See* Parkin, D. W. 02502

Delany, Audrey Claire. *See* Parkin, D. W. 02502

DeLisle, Mark. *See* Gastil, R. Gordon. 02499

02922 **DeLong, Richard M.** Bedrock geology of the South Bloomingville quadrangle, Hocking and Vinton Counties, Ohio: Ohio Div. Geol. Survey Rept. Inv. 63, 1 sheet, scale 1:24,000, section, text, 1967.

Mineral resources of the South Bloomingville quadrangle include gas from the Silurian Albion Sandstone, oil and gas from the Mississippian Berea Sandstone, and minor amounts of coal, clay, and sandstone. The reverse side of the map contains colored illustrations, geologic history, and descriptions of processes that formed Hocking Hills State Park, with notes on specific features within the park.—MCM

Denson, N. M. *See* Sato, Yoshiaki. 02468

02663 **Deuser, W. G.; Degens, E. T.** Carbon isotope fractionation in the system CO_2(gas)–CO_2(aqueous)–HCO_3(aqueous): Nature, v. 215, no. 5105, p. 1033–1035, illus., tables, 1967.

Carbon isotope fractionation between gaseous carbon dioxide and aqueous bicarbonate decreases from 9.2 to 6.8 parts per thousand over the temperature range 0°–30°C. This fractionation occurs in the hydration stage, not in the passage of atmospheric carbon dioxide through the air–water interface.—Authors' abstract

Dever, Garland R., Jr. *See* McGrain, Preston. 02750

02806 **Devereux, Owen F.** Effect of crude oil on the nuclear magnetic relaxation of water protons in sandstone: Nature, v. 215, no. 5101, p. 614–615, illus., table, 1967.

Experimental results showing three components of the nuclear magnetic relaxation curve are explained as follows: fast component, water in very fine pores; intermediate component, water in coarse pores; slow component, water in large pores that had been filled with oil and are thus coated with asphaltene. The experiment was analogous to the situation in an oil reservoir, in which some pores of the reservoir rock are largely filled with oil and some largely with water. When the rock is flushed with water from drilling mud, a nuclear magnetic signal is seen from both types of pore, but pores that have been exposed to oil have a long relaxation time; the very short signal representing fine pores is not seen because of instrumental limitations.—DBV

02995 **deVilliers, J. M.; Jackson, M. L.** Cation exchange capacity variations with pH in soil clays: Soil Sci. Soc. America Proc., v. 31, no. 4, p. 473–476, illus., tables, 1967.

The pH-dependent cation exchange negative charge (CEC) of soil clays results from the presence of a pedogenically formed aluminous chlorite, a complex consisting of positively charged hydrous alumina attached to negatively charged silicate surfaces. Part of the initially blocked isomorphous substitutional negative charge of the layer structure is released by deprotonation of $AlOH_2$ groups of the positively charged hydroxy alumina upon addition of base.—Authors' abstract

02984 **deWaard, D.** The occurrence of garnet in the granulite-facies terrane of the Adirondack Highlands and elsewhere, an amplification and a reply [of 1965 paper and to discussion by A. F. Buddington, 1966]: Jour. Petrology, v. 8, pt. 2, p. 210–232, illus., tables, 1967.

High-grade metamorphic reactions and regional-metamorphic zoning in the Adirondacks are examined in an elaboration on a previous paper (ibid., v. 6, p. 165–191, 1965) and in response to criticism by Buddington (ibid., v. 7, p. 331–335, 1966). The hypersthene isograd and the garnet–clinopyroxene isograd (Buddington's 3d garnet isograd) in the Adirondacks give comparable minimum temperatures for the region; the temperature of metamorphism was at least 700°C at the former and 760°C at the latter. Most of the Highlands had metamorphic temperatures of at least 800°C with load pressure up to 10 kb or depth of about 35 km. Water vapor pressure varied with place but was considerably lower than load pressure.—VSN

03027 **Dickey, Parke A.** Petroleum hydrogeology [abs.]: Shale Shaker, v. 18, no. 1, p. 15, 1967.

Dietz, R. W. *See* Sanders, J. V. 02830

03032 **Dobervich, George; Taylor, Ira D.** The Dalhart basin challenges the exploration geologist [abs.]: Shale Shaker, v. 18, no. 1, p. 16–17, 1967.

02521 **Doell, R. R.; Cox, A.** A spinner magnetometer for igneous rocks, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 136–141, illus., 1967.

The spinner magnetometer used in the Rock Magnetics Laboratory of the U.S. Geological Survey, designed for long-term stability, accuracy, and efficiency of operation, is described. It can measure accurately remanent magnetization of 1×10^{-5} to 1.0 Gauss, and has an ultimate sensitivity of 10^{-6} Gauss.—LLP

02524 **Doell, Richard R.; Cox, Allan.** Palaeomagnetic sampling with a portable coring drill, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 21–23, illus., 1967.

The coring unit consists of a core barrel, a transmission unit with coolant fittings, a power unit, a coolant hose and pressure tank, and an optional guide frame. Its major advantage is that any portion of an outcrop may be sampled; it is not limited to the availability of removable joint blocks. Other advantages are accuracy in assigning orientation, and in transcribing orientation marks to laboratory specimens, weight and efficiency.—LLP

02531 **Doell, Richard R.; Cox, Allan.** Measurement of natural remanent magnetization at the outcrop, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 159–162, illus., 1967.

An instrument designed to measure natural remanent magnetization at the outcrop is capable of detecting magnetization of most igneous rocks and some sediments and is of convenient size ($5\times10\times20$ cm), although it is not highly accurate or sensitive. Directions of N. R. M. to within ±20 can be measured and intensities to about 1 order of magnitude can be estimated.—LLP

02533 **Doell, Richard R.; Cox, Allan.** Analysis of spinner magnetometer operation, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 196–206, illus., 1967.

The advantage of spinner-type magnetometers of the general type described here includes high measurement accuracy and relative freedom from drift over long periods of time. The effects on accuracy of extremely non-spherical shapes and of extreme specimen inhomogeneity are surprisingly small, and with suitable precautions the effects of susceptibility anisotropy may be kept small. Spinner magnetometers thus offer many advantages in palaeomagnetic studies where accuracy is important and extremely high sensitivity is not required.—Authors' summary

02535 **Doell, Richard R.; Cox, Allan.** Analysis of alternating field demagnetization equipment, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 241–253, illus., tables, 1967.

Although partial demagnetization is an effective means of selectively removing soft unstable magnetization from igneous rock specimens, leaving the more stable thermoremanent magnetization relatively unaffected, the process may also add a spurious component of magnetization to the specimen, which in some cases, is sufficient to obscure the stable magnetization. Several studies of this spurious magnetization have been made to test the effects of external constant fields, gradients in the alternating field, suppression of even harmonics in the alternating wave form, and different modes of "tumbling" the sample within the alternating field. Proper selection of the mode of "tumbling" appears to be the most important of these factors.—Authors' summary

02536 **Doell, Richard R.; Cox, Allan.** Analysis of palaeomagnetic data, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 340–346, illus., 1967.

Several topics that seem to be generally desirable for most palaeomagnetic studies may be summarized as follows: (1) Geological setting—includes a knowledge of the structural history, stratigraphic relations, and geographic distribution of the samples chosen for study. (2) Experimental techniques—includes a description of all equipment and methods used for collecting samples, measuring remanent magnetization, and analyzing remanent magnetizations with appropriate accuracy and precision values. (3) Stability and reliability criteria—includes the results of all experiments and tests to show that the remanent magnetization directions represent those of past geomagnetic fields. (4) Presentation of data and analysis—includes a list of flow-average remanent magnetization data.—*from* Authors' summary

02537 **Doell, Richard R.; Cox, Allan.** Recording magnetic balance, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 440–444, illus., 1967.

This type of Faraday instrument was designed for rapid, routine measurements of Curie temperatures in fields up to 11,000 Oe in a vacuum or controlled atmosphere. Special features are automatic recording of the force acting on the specimen and programmed control of the magnetic field and of the heating and cooling cycle.—LLP

Doell, Richard R. *See* Cox, Allan. 02540

02834 **Donn, William L.; Shaw, David M.** The generalized temperature curve for the past 425,000 years—A discussion [of paper by Cesare Emiliani, 1966]: Jour. Geology, v. 75, no. 4, p. 497–503, illus., tables, 1967.

A correlation coefficient between the Milankovitch climate curve and the climatic record as read from deep-sea core is shown to be invalid, having been derived by Emiliani (ibid., v. 74, p. 109–124) by means of an incorrect statistical procedure. The correlation is actually insignificant. This casts considerable doubt on an empirical climate curve and an estimated rate of sedimentation.—ATM

Donnay, G. *See* Kullerud, G. 02729

02638 **Donnay, Gabrielle; Thorpe, A.; Sioda, R.; Senftle, F. E.** The formula of rhodizite: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 299–300, 1967.

A modified formula for rhodizite is proposed, as a result of electron-spin-resonance experiments. The formula $CsB_{11}Be_4Al_4O_{26}(OH)_2$, which would require only minor changes in the crystal structure, gives an atomic ratio of total oxygen to boron

of 2.54. The calculated density for this formula and for a = 7.319A is 3.38 g/cm^3.—MST

Donnay, Gabrielle. *See* Donnay, J. D. H. 02639

02647 **Donnay, Gabrielle; Barton, R., Jr.** Absolute orientation of the tourmaline crystal structure: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 299, 1967.

The authors have determined the absolute orientation of the tourmaline crystal structure by making use of anomalous dispersion of X-rays; their results confirm the orientation published by Donnay and Buerger (1950). The SiO_4 tetrahedra point toward the analogous end, which is the negative end of the c axis in traditional morphological descriptions. A survey of the singly terminated tourmaline specimens in the U.S. National Museum showed that about 75 percent exhibit the analogous end, which is usually the blunter of the two. The same result was found on two other specimens, one characterized by iron–magnesium and the other by iron lithium–aluminum.—MST

02649 **Donnay, Gabrielle.** Progress on ardennite: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 294–295, 1967.

The author reports further work on the refinement of the structure of ardennite. New cell dimensions are $a = 18.521 \pm 0.001$, $b = 5.8108 \pm 0.0008$, $c = 8.7126 \pm 0.0008$A, and cell volume is $V = 937.7 \pm 0.2$A^3. Calculated density is 3.74 g/cm^3.—MST

02650 **Donnay, Gabrielle; Senftle, F. E.; Thorpe, A.; White, S.; Ingamells, C. O.** Magnetic properties of tourmalines: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 295–299, illus., tables, 1967.

Nine different tourmalines are examined at various magnetic fields at room temperatures; detailed magnetic analyses are reported for three of the samples at temperatures down to 10°K.—VSN

02639 **Donnay, J. D. H.; Donnay, Gabrielle.** Form birefringence in fibers of vaterite, μ–$CaCO_3$: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 300–302, illus., 1967.

The authors have interpreted quantitatively, in terms of form birefringence, some measurements of the refractive index of vaterite, made by Meyer (1960, 1965). The positive fiber birefringence ($n_e - n_o = 0.087$) is smaller than the positive crystal birefringence ($n_{epsilon} - n_{omega} = 0.100$) by 0.013, which represents the amount of negative form birefringence. Therefore the tiny crystals that constitute the fiber must be platelets normal to the fiber axis. The water content can vary; at least three specimens of vaterite fiber have a water content of about six volume percent.—MST

02704 **Donnell, John R.; Tailleur, Irvin L.; Tourtelot, Harry A.** Alaskan oil shale, *in* Symposium on Oil Shale, 4th: Colorado School Mines Quart., v. 62, no. 3, p. 39–43, 1967.

In 1964, a reconnaissance project to determine the thickness, value and extent of oil-shale deposits on the Arctic Slope was initiated by the U.S. Geological Survey. The Mississippian through Jurassic beds in the structurally complex Southern Foothills belt contain oil shales of three types—tasmanite, a shale resembling the Green River, and one locally called whale-blubber rock. Fischer assays and spectrographic analyses were done on samples from all types; they yielded from 15 to 160 gal of oil per ton and many contained anomalous concentrations of gold, silver, and mercury, but because of the thinness and limited extent of known deposits, their remoteness, and adverse weather conditions, development in the foreseeable future is doubtful.—ESL

02604 **Douglas, Robert Guy.** Upper Cretaceous planktonic foraminiferal biostratigraphy of the western Sacramento Valley, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3562B—3563B, illus., 1967.

02770 **Douglass, Raymond C.** Permian Tethyan fusulinids from California: U.S. Geol. Survey Prof. Paper 593-A, p. A1-A13, illus., tables, 1967.

The Calaveras Formation in Amador and Calaveras Counties, Calif., contains fusulinid Foraminifera of Early Permian age that are similar to forms described from Japan. *Schubertella, Nagatoella, Parafusulina*, and *Misellina* are described from a large lenticular limestone in the Calaveras Formation.—RCD

02915 **Downs, Theodore.** Airlift for fossils—A field research project: Los Angeles County Mus. Nat. History Quart., v. 6, no. 1, p. 20-25, illus., 1967.

Several tons of matrix containing vertebrate microfossils from an 11,000-ft sequence on an inaccessible ridge in the Vallecito Badlands, Anza-Borrego State Park, Calif., were sacked up by the Museum party. The method by which they were transported to a base camp by helicopter is described and illustrated. The sacks were loaded in cargo nets made of nylon and attached to a tow line. This method of transportation prevented breaking of the many small bones.—ESL

03005 **Doyle, H. A.; Hales, A. L.** An analysis of the travel times of S waves to North American stations, in the distance range 28° to 82°: Seismol. Soc. America Bull., v. 57, no. 4, p. 761-771, illus., tables, 1967.

S-wave traveltimes from 20 earthquakes to North American stations at $\Delta = 28°$-82° have been studied. The deviations from J-B times were analyzed into station, source, and distance components using the least squares time-term approach. Station anomalies had a range of about 8 sec, compared with 3 sec for P-anomalies, and are believed to be due largely to variations in upper mantle velocity distribution. S-residuals, like P—residuals, were generally positive in western and negative in central and eastern United States. Within the distance range considered, the large changes of S-traveltimes required by the lower mantle velocities proposed by MacDonald and Ness (1961) are not permitted by the present data.—DBV

Doyle, Robert G. *See* Hussey, Arthur M. 02918

Drake, Avery Ala, Jr. *See* Davis, Robert E. 02723

02666 **Drever, H. I.** The lower lava group and associated picritic minor intrusions on Ubekendt Ejland, West Greenland [summ.]: Geol. Soc. London Proc. 1965-66, no. 1637, p. 52-53, 1967.

02766 **Drewes, Harald.** Geology of the Connors Pass quadrangle, Schell Creek Range, east-central Nevada: U.S. Geol. Survey Prof. Paper 557, 93 p., illus., tables, 1967.

The stratigraphic column of the area, about five miles thick, includes late Precambrian clastic rocks, Paleozoic carbonate and clastic rocks, and volcanic and terrestrial clastic rocks. Deformation occurred chiefly during the late Mesozoic but also during the Tertiary. Low-angle faults are abundant and commonly bring younger rocks onto older ones. These faults were accompanied by tear and normal faults that were variously restricted to single plates or groups of plates. Parts of some fault planes were first used by low-angle faults and later were used by high-angle faults to produce complex map relations. Evidence suggests that most upper plates moved eastward relative to the lower ones. Some low-angle faults are shallow glide faults and others are probably thrust faults. About two million dollars worth of silver has been mined and copper, lead, and zinc are present in the area.—*from* Author's abstract

02955 **DuCharme, Paul J.** Pitfalls in the economic exploitation of industrial minerals, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 132-137, 1967.

In the exploitation of industrial minerals, the role of the geologist has increased as mineral extraction has become more complex. Technological advances have necessitated more stringent quality standards and realigned markets, large equipment, and improved transportation. The environment of a deposit may affect

the profitability of its exploitation, as for example overburden, ground water, and treacherous formations. In addition to pitfalls in management and competition, efforts required to clean air, clean water and to eliminate scars are costly. With imaginative planning, there may be compensations in byproducts from ashes and wastes, new land development, and use of abandoned mines for storage areas. GDC

Dugas, Doris J. *See* Plesset, Milton. 02507

02876 **Dunham, K. C.** United States of America, *in* Symposium on the organization of geology overseas: Geol. Soc. London Proc. 1965–66, no. 1633, p. 119–125, tables, 1967.

Geological sciences in the United States began to develop with the appointment of Professor Benjamin Silliman at Yale University in 1802, and Parker Cleaveland at Bowdoin College, Maine, in 1805. Soon after the second decade the first state geological surveys were created. The earliest federal surveys were connected with military expeditions and led to organization of the U.S. Geological Survey in 1879, and to systematic study of the geology and mineral resources of the country. About 25,000 geologists are believed to be employed in the United States; their distribution in 1964 is compared with 1960 and 1954. University training in geology and geophysics, and work of the USGS Divisions, are summarized; USGS research expenditures are compared with those of the National Science Foundation, universities, and industry.—GDC

Dunn, James R. *See* Cutcliffe, William E. 02949

02428 **Durham, J. Wyatt; MacNeil, F. Stearns.** Cenozoic migrations of marine invertebrates through the Bering Strait region, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 326–349, tables, 1967.

Marine molluscan genera that have simple biogeographic histories and that originated and developed in the middle and higher latitudes of the North Pacific and North Atlantic Oceans are most significant in evaluating marine migrations through Bering Strait and the Arctic Ocean. The available evidence suggests that no transarctic Cenozoic marine migrations occurred earlier than about late Miocene (Pontian) time; during late Pliocene and Pleistocene time, migrations are well documented. These data do not require the connecting seaways to have remained open continuously after their first establishment. It seems more probable that the seaways were intermittently open and closed, but the molluscan paleontologic data on hand do not permit accurate dating of these fluctuations.—Authors' abstract

Dyni, John R. *See* Hite, Robert J. 02690

02789 **Dyrness, C. T.** Erodibility and erosion potential of forest watersheds, *in* Forest hydrology—Natl. Sci. Found. Advanced Sci. Seminar, University Park, Pa., 1965, Proc.: London and New York, Pergamon Press, p. 599–611, 1967.

This paper reviews literature dealing with forest soil erosion and erodibility; generally stressed are resistance of soil particles to detachment and transport, and soil infiltration rate. Factors influencing erodibility indices include soil parent material, organic matter content, climatic conditions, and soil chemical properties. Many studies have shown that infiltration rate decreases with removal of plant and litter cover, thus exposing mineral soil to destructive action of rain. Erosion is accelerated by road construction, logging, and fire, although light burning has apparently little effect.—GDC

02693 **Eales, Hugh V.** Reflectivity of gold and gold–silver alloys: Econ. Geology, v. 62, no. 3, p. 412–420, illus., table, 1967.

Reflectivities of gold–silver alloys between 500 and 1,000 fine are given tor six wavelengths. Polishing techniques, particularly with nearly dry laps, affect reflectivity values. In the range 800 to 1,000 fine, composition can be determined without a reflectometer by finding the wavelength at which reflectivity of gold and associated pyrite are the same.—WSW

02498 **Eardley, A. J.** Bonneville chronology—Correlation between the exposed stratigraphic record and the subsurface sedimentary succession: Geol. Soc. America Bull., v. 78, no. 7, p. 907–909, illus., 1967.

The Pleistocene chronology of the Bonneville basin, Utah, based on a stratigraphic study of exposed sediments, together with radiometric dates, correlates with a 650-ft core from the southeast margin of the Great Salt Lake. Basin sediments show a more definitive record for pre–Wisconsin stages.—JJH

02966 **Earley, Charles F.** The sediments of Card Sound, Florida: Florida State Univ. Sedimentol. Research Lab. Contr. 18, 72 p., illus., tables, 1967.

The distribution and characteristics of the surface sediments of Card Sound and adjacent Continental Shelf were studied. Considerable differences were found to exist between sediments on the shelf and those within the sound. The shelf sediments are entirely carbonate, composed primarily of aragonite and high magnesium calcite, and a smaller amount of low magnesium calcite. In Card Sound the presence of detrital quartz creates a dual-component system. Low magnesium calcite is the predominant carbonate although aragonite and high magnesium calcite also occur; the distribution of quartz in the several size fractions shows the nature of sediment transport and reflects the energy of the transportational agents.—*from* Author's abstract

02743 **Earth Science Curriculum Project.** Investigating the Earth: Boston, Mass., Houghton Mifflin Co., 594 p., illus., tables, 1967.

This textbook of introductory geology, designed for the high school student, has a broad scope which includes aspects of astronomy, meteorology, and oceanography. The 26 chapters are: the changing Earth; Earth materials; Earth measurements; Earth motions; fields and forces; energy flow; energy and air motions; water in the air; waters of the land; water in the sea; energy, moisture, and climate; the land wears away; sediments in the sea; mountains from the sea; rocks within mountains; interior of the Earth; time and its measurement; the record in the rocks; life—present and past; development of a continent; evolution of landscapes; the Moon—a natural satellite; the solar system; stars as other suns; stellar evolution and galaxies; the universe and its origin.—LLP

02897 **Eckel, Edwin B.** Effects of the earthquake of March 27, 1964, on air and water transport, communications, and utilities systems in south-central Alaska: U.S. Geol. Survey Prof. Paper 545-B, p. B1–B27, illus., 1967.

Transportation, utilities, and communications systems were wrecked or severely damaged over much of south-central Alaska by the March 1964 earthquake. Effects on air transportation amounted to a few planes damaged by seismic vibration or flooding, and numerous airports damaged by vibration, sea waves, tectonic subsidence, and compaction. The effects on the shipping industry were far more serious. All port facilities in the area were destroyed or severely damaged by slides, waves, tectonic uplift, and fire; many boats and navigation aids were destroyed; and waterways were altered by uplift or subsidence. A complex power-generating system was disrupted by damaged equipment and broken lines, many petroleum storage tanks were lost or broken, and gas, water-supply, and sewer lines were broken.—LLP

02472 **Eddy, J. E.; Henry, V. J.; Hoyt, John; Bradley, Edward.** Description and use of an underwater television system on the Atlantic Continental Shelf, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C72–C76, illus., 1967.

Relatively inexpensive underwater closed-circuit television cameras and a monitor, which were adapted first for use in boreholes, were used to obtain a 500-line resolution picture of the Continental Shelf off the Georgia coast. Illumination for viewing the bottom at night or on deep parts of the shelf was provided by 1,000-watt quartz lights mounted with the television camera on a steel-framed sled. The sled rested on the sea floor or was towed slowly behind a ship. Physical characteristics of the bottom as well as considerable biological activity were recorded

by photographing the television monitor using both 35-mm still pictures and 16-mm motion pictures.—Authors' abstract

Eden, W. J. *See* Raymond, Gerald P. 02746

02983 **Eggler, Willis A.** Influence of volcanic eruptions on xylem growth patterns: Ecology, v. 48, no. 4, p. 644–647, illus., 1967.

Xylem formed in four pine trees growing near Parícutin Volcano, Mex., during eight years of volcanic activity had several kinds of abnormalities including narrow, wide, asymmetrical and incomplete annual growth layers, and abnormally low as well as high ratios of dense to porous wood. Five other pine trees were studied 12 years after volcanic activity had ceased. Only one of them was consistently producing normal annual growth layers. Among the others porous wood was produced almost exclusively, making it impossible to correlate growth layers with years. Reduced supplies of photosynthate, poor aeration, and abnormal supply of auxin may be responsible for the abnormal growth pattern.—Author's abstract

02478 **Ehrlich, Garry G.; Schoen, Robert.** Possible role of sulfur-oxidizing bacteria in surficial acid alteration near hot springs, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C110–C112, 1967.

Explanations of sulfuric acid production near hot springs on the basis of purely inorganic mechanisms have not been convincing because of slow reaction rates. Presence of sulfuric acid producing bacteria in the soil of Steamboat Springs, Nev., was confirmed by comparing cultures inoculated with natural soil samples containing bacteria to cultures inoculated with sterilized soil. Involvement of these bacteria in surficial acid alteration is suggested.—Authors' abstract

Eisler, Joseph. *See* Carder, Dean S. 02997

Ekren, E. B. *See* Rogers, C. L. 02555

02563 **ElBoushi, Ismail Mudathir.** Geologic interpretation of recharge through coarse gravel and broken rock [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3990B, 1967.

02449 **Elsasser, Walter M.** Interpretation of heat flow equality: Jour. Geophys. Research, v. 72, no. 18, p. 4768–4770, 1967.

An argument in favor of a dynamical foundation for the equality of heat flows from the continents and ocean floors is presented. The continents are idealized as rigid plates floating on an upper mantle capable of deformation, and the oceanic crust is considered to be negligibly thin. If convection in the upper mantle is purely thermal, motions will occur in such a way as to reduce the convection-generating temperature differences and the system will tend to approach a state of mechanical equilibrium. Under certain simplifying but not too severe assumptions, it is shown that in hydrostatic equilibrium the isothermal surfaces must be level; they must be the same under oceans as under continents. If thermal conductivities near the surface are equal, then heat flows must be equal also.—DBV

02605 **Elson, John Albert.** Surficial geology of the Tiger Hills region, Manitoba, Canada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3563B, 1967.

02564 **Emerson, John Wilford.** Stratigraphy and petrology of upper Chester rocks in northern Alabama [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3990B–3991B, 1967.

England, J. L. *See* Boyd, F. R. 02726

England, J. L. *See* Bell, Peter M. 02728

Engler, Vivian L. *See* Smith, Merritt B. 02999

Epstein, Jack B. *See* Davis, Robert E. 02723

02557 **Esmaili, Houshang.** A solution for determination of aquifer characteristics and unsteady flow through injection wells by numerical methods [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3923B, 1967.

02763 **Espenshade, G. H.; Boudette, E. L.** Geology and petrology of the Greenville quadrangle, Piscataquis and Somerset Counties, Maine: U.S. Geol. Survey Bull. 1241-F, p. F1-F60, illus., tables, geol. map, 1967.

Slate, siltstone, and sandstone of probable Silurian to Early Devonian age are intruded by a large mafic body (Moxie pluton) and two granitic stocks of probable Early Devonian age. The sedimentary rocks are in the chlorite zone of metamorphism except in the contact aureoles where metamorphic zones range from biotite through andalusite-amphibole to sillimanite-cordierite adjacent to intrusions. Troctolite and norite are the principal rock types in this part of the Moxie pluton; they consist of magnesium-rich and iron-rich varieties whose compositions are shown by modal and chemical analyses. Plagioclase, olivine, and orthopyroxene have wide compositional ranges. The felsic stocks consist of quartz monzonite and granodiorite. Slate quarrying has been the main mineral industry. Small amounts of sulfides are known locally in the Moxie pluton.—GHE

02673 **Essene, E. J.; Fyfe, W. S.** Omphacite in Californian metamorphic rocks: Contr. Mineralogy and Petrology, v. 15, no. 1, p. 1-23, illus., tables, 1967.

Omphacite is a common mineral in greenstones, metasediments, and related Franciscan rocks of the glaucophane schist facies. It also occurs in late veins cutting amphibolites, glaucophane schists, eclogites, greenstones, and occasionally metagraywackes. It is apparent that this mineral is stable under glaucophane schist facies conditions in rocks of suitable bulk composition, and is not restricted to the eclogite facies. Association with albite, quartz and lawsonite, and late veining of omphacite veins by aragonite indicates that pressures necessary to form omphacite are reasonably close to those calculated from an ideal solution model.—Authors' abstract

Evans, Bernard W. *See* Moore, James G. 02980

02565 **Evans, James George.** Structural analysis and movements of the San Andreas fault zone near Palmdale, southern California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3991B, 1967.

02959 **Everett, Floyd D.** Potential pozzolanic materials, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 156-161, 1967.

The classes of pozzolan materials used in the United States have been volcanic glasses, opal or opaline rocks, clay minerals, and fly ash; their substitution for a portion of the cement in concrete has many advantages. The only effective means of identifying good pozzolanic material is by several expensive physical tests, although optical tests usually can screen out unsatisfactory material. A recent Bureau of Mines program led to comprehensive tests of 276 samples; criteria for sampling favored actively used material, large occurrence, and proximity to railroads or potential market centers; data are to be in files of Mineral Resource Area offices according to sample location. Exploitation of natural materials is limited by restricted uses and by competition with pozzolanic fly ash, except in California.—GDC

02802 **Everett, K. R.** Mass-wasting in the Tasersiaq area, West Greenland: Medd. om Grønland, v. 165, no. 5, 32 p., illus., tables, 1967.

This ice-free area, marginal to the Sukkertoppen Iskappe, is underlain by jointed granite and gneiss, with only a thin covering of ground moraine. Solifluction lobes occur on both valley slopes, but sheets are restricted to the gentler northeast-facing slope. Many sheets and lobes show imbrication of boulders on their frontal margin

and appear to be of recent age, but slump features showing imbrication are both recent and fossil. Micromudflows and debris slides move the greatest volume of material. No recent large mudflow activity was seen. Water (on the surface and under pressure) and wind are important contributors to mass wasting. Qualitative and quantitative observations suggest that the processes are operating at a rate two to three times faster on the northeast-facing slope than on the other.—*from* Author's abstract

03002 **Evernden, J. F.** Magnitude determination at regional and near-regional distances in the United States: Seismol. Soc. America Bull., v. 57, no. 4, p. 591–639, illus., tables, 1967.

Study of variation of Pn amplitudes in the 200–2,100 km range shows that patterns of Pn amplitude versus Δ in the western and eastern United States are markedly different, the differences being related to differences in velocity structure that extend at least to 150 km depth. None of the amplitude patterns resemble that proposed by Gutenberg and Richter in the 1,000–2,000 km range. Consistent estimates of magnitude at all distance ranges are now possible for most explosions and earthquakes. Consistent estimates of amplitude as a function of distance require a knowledge of energy distribution between the refracted phases used between 200 and 2,500 km distance. Patterns of energy radiation and decay are best determined from explosion data.—DBV

02627 **Eye, John David.** Aqueous transport of dieldrin residues in soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3548B–3549B, 1967.

02873 **Fabregat Guinchard, Francisco J.** El cálculo cristalográfico matricial: Geología y Metalurgia, v. 3, no. 19, p. 69–93, illus., tables, 1967.

The use of matrices in crystallographic calculation facilitates the conversion of one fundamental reference system to another. The fundamental reference systems are: (1) experimental system: orthogonal trihedron (xyz) Cartesian X, (2) direct M (abc) system, involving three crystallographic axes, and (3) reciprocal M* (a*b*c*) system, involving three perpendiculars to the trihedron faces. The relationships among the systems and the use of the matrices M and M* are discussed. The application of matricial calculation is shown by the case of a triclinic, holohedral durangite crystal discovered in Mexico.—LLP

02606 **Fagan, John J.** Carboniferous cherts, turbidites and volcanics in northern Independence Range, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3563B, 1967.

02824 **Fairbridge, Rhodes W.; Richards, Horace G.** The INQUA Shorelines Commission [with German and French abs.]: Zeitschr. Geomorphologie, new ser., v. 11, no. 2, p. 205–215, 1967.

An elucidation of shoreline history, region by region, can be of great value in establishing base-level at any time and relating to the world climate trend. The multiple groups and agencies considering various aspects of the problem are introduced, and the history of the Commission since it was established in 1953 is reviewed. The Annotated Bibliography of Quaternary Shorelines from 1945–1964 has been published. Research is needed on stability criteria, hydro-isostatic deformation, coral reef correlation, criteria for eustasy and its terminology, and stratigraphic nomenclature. Reports of the five regional subcommittees are summarized.—ESL

Fairhurst, Charles. *See* Haimson, Bezalel. 02833

02528 **Farrell, W. E.** The resonance magnetometer, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 100–103, illus., 1967.

A short-period resonance magnetometer capable of measuring intensities of magnetization greater than 1×10^{-6} Gauss (assuming a 5-cm^3 sample located 2.5

cm from the lower magnet) is described. The intensity limit which is set by vibrational disturbances can be reduced by proper location and design of the magnet system and supporting structure.—LLP

Fatt, I. *See* Saraf, D. N. 02852

02590 **Feulner, Alvin J.; Heyward, Henry H.; Angelo, Clifford G.** Use of an infiltration gallery to obtain fresh water at Ocean Cape, Alaska, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C189-C191, illus., 1967.

Sufficient water for a military facility at Ocean Cape has been obtained during the past 3 1/2 years from a horizontal infiltration gallery that taps a layer of fresh [ground] water resting on saline water. The gallery, which is 5 feet above mean sea level and 250 feet inland from the shoreline, supplants a well at the same general location. When first installed, the well yielded water of satisfactory quality, but within 2 years the chloride content of the water increased to more than 500 ppm.—Authors' abstract

02819 **Findlay, D. C.** The mineral industry of Yukon Territory and southwestern District of Mackenzie, 1966: Canada Geol. Survey Paper 67-40, 104 p., tables, 1967.

With a few exceptions, lode and placer properties described in this review were being actively worked or explored during 1966. The value of Yukon mineral production declined about 4 million dollars from 1964 to 1966, but several new prospects for copper, asbestos, and lead-zinc should arrest this trend for 1967. Brief descriptions are given of areas where the Geological Survey of Canada is continuing its program of reconnaissance geological mapping. Mining properties described are grouped into lode mining and exploration, placer mining, and coal mining and exploration. Dredging operations in the Klondike area have been terminated, bringing to a close over 45 years of operations.—MCM

02771 **Finn, W. D. Liam.** Static and seismic behaviour of an earth dam, *in* Papers presented at the 19th Canadian Soil Mechanics Conference, Pt. 1: Canadian Geotech. Jour., v. 4, no. 1, p. 28-37, illus; reply to discussion, p. 44, 1967.

The finite element method of analysis provides a complete description of stresses and deformation in an earth dam due to static and seismic loadings. Correlation between the predicted and measured deformations of the Otter Brook Dam, New Hampshire, during construction suggests that the method predicts deformation adequately. The probable seismic response of the dam, built of glacial till, is computed using this method. An appendix contains a description of the finite element method.—ESL

02846 **Finney, V. L.** Origin of two-dimensional dendrites: South Carolina Div. Geology Geol. Notes, v. 10, no. 4, p. 57-58, illus., 1967.

The origin of 2-dimensional dendrites on cleavage surfaces in shale is explained on the basis of observations of man-made dendrites produced while polishing slabs of rocks with a corundum-water mixture on a glass surface. Dendrite patterns will be produced only in those planes where sufficient cohesion between surfaces and viscosity of the fluid is reached, and where some ion which will leave a stain is in solution.—LLP

02931 **Fischer, Alfred G.; Garrison, Robert E.** Carbonate lithification on the sea floor: Jour. Geology, v. 75, no. 4, p. 488-496, illus., 1967.

As evidence of direct precipitation of calcite from sea water and of lithification without burial, the authors describe limestone crusts from the eastern Mediterranean sea bottom. These have micritic fillings of interstices and of foraminiferal chambers. Photomicrographs, electronmicrographs and X-ray diffractograms of limestone dredged from the sea bottom off Barbados show similar micrite-filled chambers.—REW

02651 **Fisher, G. W.** The effect of variable oxygen activity on isograd reactions in pelitic rocks: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 279–283, illus., 1967.

Metamorphic zoning in pelitic rocks is dependent not only on three main variables—P, T, and activity of water, but also on others such as oxygen activity. In studying the effects of variable oxygen activity it would be advantageous to predict which reactions are most sensitive to the variations. To do this the topology of reactions between the biotite, chlorite, chloritoid, cordierite, garnet, kyanite, and staurolite in the presence of quartz and muscovite, was calculated for conditions approximating the staurolite zone of metamorphism. A figure showing the topology of these reactions at constant P and activity of water, in terms of variables T and oxygen activity is given. The results suggest that if oxygen activity varies greatly from bed to bed in a metamorphic sequence, the mineral assemblages and the position of the isograds may be expected to vary accordingly.—MST

02658 **Fisher, G. W.** Fe–Mg olivine solid solutions: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 209–217, illus., 1967.

An experimental investigation of the olivine solid solutions series was begun to understand better the subsolidus equilibrium relations in the system MgO–FeO–SiO_2–H_2O–O_2, and especially within the smaller system MgO–SiO_2–H_2O. The data on the compositions of olivines is described, and their significance of the results in relation to metamorphism of iron formations is discussed.—MST

02951 **Fisher, W. L.; Rodda, Peter U.** Stratigraphy and genesis of dolomite, Edwards Formation (Lower Cretaceous) of Texas, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 52–75, illus., table, 1967.

The shallow marine platform of this formation was bounded by deeper basins of lime muds. Remnants of evaporites deposited in the Kirschberg Lagoon now outcrop in central Texas; those in the McKnight Lagoon are subsurface in southwestern Texas and northern Mexico. Main outcrops of dolomite are in a concentric belt marginal to the Kirschberg facies, mostly stratal types on the north and massive on the south. Both types are judged to be products of metasomatic replacement from contact with magnesian-rich brine waters, very early in the stratal form and post-lithification in the massive. Nodular chert is coextensive with dolomite but not in the rudist reef-core or reef-flank deposits within the dolomite facies. Dense hard limestones of the reef core are rarely dolomitized.—GDC

02460 **Flerow, C. C.** On the origin of the mammalian fauna of Canada, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 271–280, 1967.

Most mammal species in Canada are of Asiatic origin and provide extensive data concerning Beringia's role in faunistic history. Studies indicate the Bering land bridge appeared first in the Paleocene and vanished and appeared again repeatedly. Migrations of adaptable mammal species took place at intervals during the Pleistocene. Eastern Asian species are characteristic of northern latitudes of North America, and a second, less closely related group of mammals that migrated before the maximum glaciation, is distributed in the south. Bison history is used to illustrate effects of differences between Siberian and North American glaciation. At the end of the Wisconsin, the range of bison began to shrink, was completely disrupted by the Holocene, and they became extinct over large areas. After the thermal maximum, only the musk ox and wood bison persisted where Pleistocene landscapes were preserved.—ESL

Flinn, E. A. *See* Archambeau, C. B. 03008

Flueckinger, Linda A. *See* Beutner, Edward C. 02583

02848 **Folk, Robert L.** Sand cays of Alacrán Reef, Yucatán, Mexico—Morphology: Jour. Geology, v. 75, no. 4, p. 412–437, illus., tables, 1967.

The seven sand cays of Alacrán Reef which occur on the leeward side of a nearly filled atoll, are composed of fine to coarse carbonate sand, finer on the lee side of the cay; coral-stick gravel ramparts occur on two islands facing heaviest surf. Cays are of five recognizable types, four of which form an evolutionary sequence. The most mature cays have a central vegetated flat with a mildly saucer-shaped profile, a high dune ridge on the lee side next to shore, and steeper and narrower beaches on the windward side. Islands have greatly enlarged in area in the last 60 years, and tend to shift leeward. A review of the literature on carbonate cays reveals their similarity in many respects to other carbonate cays in the tropics.—*from* Author's abstract

Forsyth, Jane L. *See* Goldthwait, Richard P. 02962

02464 **Foster, Margaret D.** Tetrasilicic dioctahedral micas—Celadonite from near Reno, Nevada, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C17-C22, illus., tables, 1967.

The end result of replacement of 2 R^{+3} by $R^{+2}Si$ in muscovite is tetrasilicic mica in which half the octahedral cations are trivalent and half are bivalent. A comparative study of the formulas calculated from seven published analyses of tetrasilicic or near-tetrasilicic dioctahedral micas shows that the formula calculated from the analysis of celadonite from near Reno, Nev., is closer to that of the theoretical ($Fe^{+3}Mg$) tetrasilicic end member than are the formulas calculated from any other analyses. This celadonite gives a well-resolved X-ray diffraction pattern and consists of a single phase.—*from* Author's abstract

02882 **Frakes, Lawrence A.** Stratigraphy of the Devonian Trimmers Rock in eastern Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G 51 (General Geology Rept.), 208 p., illus., tables, 1967.

The Trimmers Rock Member of the Fort Littleton Formation, up to 4,000 feet thick in Pennsylvania, is divisible into ten siltstone-shale units. It and its counterparts, exposed throughout the Valley and Ridge province of the central Appalachians, represent relatively deep-water marine deposits of the Catskill delta. Sedimentary features indicate in general that the Devonian paleoslope in eastern Pennsylvania was to the north-northwest, and a younger one in south-central Pennsylvania to the northwest. Ripple marks show early northward paleocurrents deflected westward at the foot of the paleoslope. The graywackes and conglomerates of the Trimmers Rock Member are deficient in feldspar and contain few recognizable igneous or metamorphic rock fragments, suggesting as source area a broad sedimentary terrain of moderate relief in parts of the present Great Valley, Piedmont and Coastal Plain.—GDC

Franklin, G. J. *See* Kehn, T. M. 02585

03006 **Freedman, Helen W.** Estimating earthquake magnitude: Seismol. Soc. America Bull., v. 57, no. 4, p. 747-760, illus., table, 1967.

The disturbingly large variation in magnitude estimates observable in any earthquake catalogue has led to this analysis of one particular catalogue and definition of magnitude. The method employed by the United States Coast and Geodetic Survey is analyzed in the light of theoretical considerations concerning the probability distribution of the variables involved. In particular, the truncation procedure seems to lead to estimates which consistently underestimate the magnitude for large earthquakes, and perhaps overestimate the magnitude for small ones. An alternative method is suggested which leads to estimates which are in good agreement with those provided by Berkeley, Pasadena, and Lamont.—Author's abstract

French, Robert R. *See* Rooney, Lawrence F. 02874

02783 **Friend, P. F.** Clay fractions and colours of some Catskill (Devonian) red beds [abs.]: Geol. Soc. London Proc. 1965-66, no. 1632, p. 78; discussions and replies, p. 78-82, 1967.

Fuchs, K. *See* Landisman, M. 03011

02517 **Fuller, M. D.** The a.c. bridge method, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 403–408, illus., 1967.

The a.c. method measures susceptibility by making use of the change of inductance of air-cored coils caused by the introduction of a rock specimen. The fractional change of inductance is linearly proportional to the susceptibility of the specimen and the volume ratio of the sample to the air space.—LLP

Fuller, M. D. *See* Kobayashi, Kazuo. 02539

02869 **Fuller, M. D.; Kobayashi, Kazuo.** Identification of magnetic phases in certain rocks by low-temperature analysis, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 529–534, illus., 1967.

Analysis of remanence and identification of magnetic mineral phases by low temperature analysis are described. Although the method is currently limited due to low sensitivity of observation and lack of knowledge of magnetic mineral behavior at low temperatures, it may be extended to analysis of the N.R.M. of red beds.—LLP

Fyfe, W. S. *See* Essene, E. J. 02673

02676 **Gabe, E. J.** Computer programs for X-ray crystallography—Pt. 1, Bond and angle scan program: Canada Dept. Energy, Mines and Resources Mines Br. Research Rept. R 189, 19 p., illus., 1967.

This program which is the first in the series is designed to facilitate the interpretation of the results of crystal structure analysis. Using the unit cell data, the fractional atomic coordinates, and the symmetry operations, the program finds the coordinates in terms of distances and angles around a specified group of atoms of interest. The program will handle all types of symmetry and there are essentially no limits on the size of structure that can be dealt with other than the size of the memory of the computer.—Author's abstract

02566 **Galehouse, Jon Scott.** Provenance and paleocurrents of the Paso Robles Formation [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3991B, 1967.

02953 **Galle, O. Karmie.** The geochemistry of the Oread Limestone, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 97–109, illus., tables, 1967.

The four limestones of the Oread Limestone, basal formation of the Shawnee Group of Pennsylvanian age, were systematically sampled along the entire length of outcrop in eastern Kansas, for chemical analysis. Major impurities found were silica in all four limestones, dolomite and iron in the Toronto member, and pyrite in the Leavenworth. In general the purity (amount of $CaCO_3$) tends to increase toward the southern edge of the outcrop area. The Kereford, Plattsmouth and Toronto limestones are thick enough at various locations to be useful economically. Included in this paper are tables of chemical analyses, graphs of various constituents, and a map of sampling locations. Specific analytical techniques are described and chemical trends noted.—GDC

Gard, Theodore M. *See* Beutner, Edward C. 02583

Garrison, Robert E. *See* Fischer, Alfred G. 02931

02499 **Gastil, R. Gordon; DeLisle, Mark; Morgan, JR.** Some effects of progressive metamorphism on zircons: Geol. Soc. America Bull., v. 78, no. 7, p. 879–905, illus., tables, 1967.

To investigate metamorphism of zircons, metamorphic aureoles of the Mesozoic pluton at Owlshead Peak, Calif. and the Mesozoic batholith, White Mountains, Calif., and the progressive zones of Paleozoic regional metamorphism, Vermont and New Hampshire were studied. Results confirm the following: metadetrital zircons refacet only at near-melting conditions and even then are distinguishable from typical igneous crystals; uranium-plus-thorium content decreases with increased grain size; lead loss is closely related to uranium-thorium content; and independent of uranium-thorium content, zircons show increased lead loss with increased grade of metamorphism, the degree of loss appearing to increase with duration of heating. The loss of color in hyacinth zircons is a function of maximum temperature rather than thermal duration.—*from* Authors' abstract

02805 **Geological Society of America.** (North-Central Section). Geologic tales along Hoosier trails—Geol. Soc. America, North-Central Sec., 1st Ann. Mtg., 1967, field trip guidebook: Bloomington, Ind., Indiana Univ. Dept. Geology and Indiana Geol. Survey, 133 p., illus., 1967.

This guidebook contains four field trip papers, by R. L. Powell and W. D. Thornbury, C. B. Rexroad and R. W. Orr, A. F. Schneider and W. J. Wayne, and L. F. Rooney and others, which are cited separately.—VMJ

02901 **George, P. T.; Brown, D. D.; Bennett, G.; Leahy, C. J.** Operation Kapuskasing: Canadian Mining Jour., v. 88, no. 4, p. 129-136, 1967.

Mineral deposits of a large area north of Timmins and south of James Bay, Ontario were studied by helicopter-supported reconnaissance by the Ontario Department of Mines. Base metals, iron, gypsum, fire clay, kaolin, quartz sand, niobium, thorium, uranium, gold, lithium, and possible diamond deposits were located. ARK

02453 **Gershanovich, D. E.** Late Quaternary sediments of Bering Sea and the Gulf of Alaska, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 32-46, illus., 1967.

In the Bering Sea and Gulf of Alaska, Quaternary sediments are of two types: those stratified by regular sedimentary processes, and those produced by local processes such as landslides and volcanoes, superimposed on the first. Distribution of principal types of postglacial deposits is discussed and shown on a sketch map; thickness varies from 0.3 to 3 m, being thinner on the outer edge of the shelf. Fine clastic material has accumulated in submarine valleys in the Gulf of Alaska. The continental slope and rise are also covered with a considerable thickness in most places, with thinner sediments on the abyssal plains. Rate of sedimentation on the shelf ranges from 2 to 30 cm/1,000 yr, and varies even more on the slope. Late glacial deposits are more homogeneous and poorer in organic content than postglacial. The different lithology is due probably to differences in the weathering processes.—ESL

02551 **Giblin, P. E.** Highway 101, Chapleau to Wawa, Districts of Sudbury and Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 423, scale 1 in. to 1 mi., text, 1967.

Throughout much of its 80-mile length, this section of Highway 101 traverses country which has received little or no geologic mapping. This limited survey includes only outcrops along the side of the highway and no attempt is made to extrapolate features beyond the very narrow zone. Rocks exposed are of Precambrian age and consist of mafic metavolcanics, felsic intrusive rocks, diabase and lamprophyre dikes. Pleistocene moraine, silty to sandy till, overlies most of the region with minor areas mantled by lacustrine deposits of sand and silt. Faulting is common, foliation strikes mainly northeast to east, and dips are steep. The area may merit prospecting for molybdenite occurrences. Sand and gravel occur abundantly and have been used extensively in road construction.—MCM

02662 **Gilbert, Charles M.** Acmite: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 241-244, illus., 1967.

Because of its importance in petrology the pyroxene end member acmite has been studied at high pressure. The significant observations from the work so far accomplished are: (1) incongruent melting persists to 45 kb, (2) oxygen pressure has a strong influence on acmite melting, (3) incongruency is maintained from high to low oxygen pressures, and (4) the initial slope of the incongruent melting curve presented is surprisingly steep—about 20°C per kb, one of the steepest of any silicate yet investigated.—MST

Gilbert, J. F. *See* Backus, G. E. 02948

Gilbert, M. C. *See* Boyd, F. R. 02726

Gilbert, M. Charles. *See* Richardson, S. W. 02654

Giles, D. L. *See* Cruft, E. F. 02692

02993 **Giles, Leland H.** A simplified method for preparation of soil thin sections: Soil Sci. Soc. America Proc., v. 31, no. 4, p. 570–572, illus., 1967.

A simplified method for thin section preparation requires a relatively small amount of materials and time. Heating is required only twice, no evacuation is necessary, and only one impregnating solution is used. A ratio of 3.5 parts of acetone to one part of Laminac resin is used for impregnation, with Lupersol DDM as a catalyst. Impregnated chips and cover glasses are attached to slides with clamps, using epoxy as a cementing agent. The method has satisfactorily impregnated both noncalcareous and highly calcareous soil materials ranging in texture from clay to loamy sand, with and without gravel.—Author's abstract

02697 **Gillerman, Elliot.** Structural framework and character of mineralization, Burro Mountains, New Mexico: Econ. Geology, v. 62, no. 3, p. 370–375, illus., 1967.

Faults divide the Big Burro Mountains into three separate blocks; the central Tyrone–Burro Peak block is a horst uplifted along the Austin–Amazon and Sprouse–Copeland faults. Mineral deposits of the different blocks are characterized by different metal contents believed to be a function of both vertical zoning and relative uplift of the blocks. Most distinctive is the absence in the Tyrone–Burro Peak block of all minerals except chalcopyrite and the ubiquitous pyrite. In the adjacent blocks, lead, zinc, silver, gold, bismuth, and specular hematite are present in commercial quantities in addition to copper. Copper minerals formed at greater depths are exposed at the surface only in the uplifted central block. All base metal and precious metal deposits that may have existed above the chalcopyrite have been removed as a consequence of the uplift.—*from* Author's abstract

02554 **Gilluly, James.** Geologic map of the Winnemucca quadrangle, Pershing and Humboldt Counties, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ–656, scale 1:62,500, sections, 1967.

02681 **Glaciology Panel.** Glaciology in the Arctic: Am. Geophys. Union Trans., v. 48, no. 2, p. 759–767, 1967.

This review of problems of Arctic glaciology was prepared by the Glaciology Panel of the Committee on Polar Research of the NAS–NRC. The problems concerning Arctic sea ice, glaciers, seasonal snow cover, permafrost, Quaternary chronology, and logistics and support are outlined, and recommendations are made for theoretical and experimental investigations of these problems.—DBV

02687 **Glass, B. P.; Heezen, B. C.** Tektites and geomagnetic reversals: Sci. American, v. 217, no. 1, p. 32–38, illus., 1967.

Tektites occur in marine sediments from the Indian Ocean and South Pacific that are about 700,000 years old. This age is coincident with that of tektites found in Australia and southeastern Asia, with the last reversal of the Earth's magnetic field, and with an abrupt change in the populations of marine microfauna. Microscopic spherules of glass were scattered over the Tunguska Valley forest,

Siberia, in the explosion of 1908. Geomagnetic reversals and tektites may have been produced by collisions with large cosmic bodies.—DWR

03023 **Goebel, Edwin D.** Mississippian rocks of western Kansas [abs.]: Shale Shaker, v. 18, no. 1, p. 14, 1967.

02425 **Goldstein, J. I.** Distribution of germanium in the metallic phases of some iron meteorites: Jour. Geophys. Research, v. 72, no. 18, p. 4689–4695, illus., tables, 1967.

Ge distributions in 10 iron meteorites with bulk Ge contents of 8.7 to 2,000 ppm have been measured by electron-probe microanalysis. Ge is concentrated almost entirely in the metallic phases. It was redistributed in the temperature range at which the Widmanstätten pattern developed. Ge content shows a positive correlation with Ni content, reaching a maximum in taenite and a minimum in kamacite at the kamacite-taenite interface. The distribution coefficient of Ge between kamacite and taenite is relatively constant. The distribution of Ge is discussed in terms of its trace element behavior and its covariance with Ni. Author's abstract

02962 **Goldthwait, Richard P.; White, George W.; Forsyth, Jane L.** Glacial map of Ohio: U.S. Geol. Survey Misc. Geol. Inv. Map I-316, scale 1:500,000, revised 1967; originally published 1961.

Revisions of the 1961 edition were made by J. L. Forsyth from data published by the Ohio Division of Geological Survey in their Bulletin 59 (1961) on Knox County, Bulletin 60 (1962) on Fairfield County, and Report of Investigation (in preparation) on Licking County.—MCM

Gorsline, D. S. *See* Yerkes, R. F. 02476

02520 **Gough, D. I.** The spinner magnetometer at Salisbury, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 119–130, illus., table, 1967.

A spinner-type rock remanent magnetometer measures specimens of moments from 2×10^{-6} Gauss cm^3 upward and measures moments from 10^{-5} Gauss cm^3 with precisions of 1° in direction and of five percent in magnitude. The lower limit of measurement corresponds to an intensity of magnetization of 5×10^{-8} Gauss cm^3 for the largest specimen size which can be accomodated. Annulment of the geomagnetic field at the rotor is shown to be desirable when rocks having low remanence and high susceptibility are to be measured.—*from* Author's summary

02523 **Gough, D. I.** Notes on rock sampling for palaeomagnetic research, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 3–7, 1967.

A satisfactory sampling scheme for paleomagnetic studies must consider (1) causes of scatter in directions of magnetization—secular variation of the geomagnetic field, tectonic movement of rock, heating of rock, lightning discharges to ground, viscous magnetization, formation of oxides giving rise to chemical magnetization, and instrumental error; (2) location of sampled exposures; five or more sites should be sampled in a rock unit, spaced widely over the maximum available stratigraphic column of sediments or lavas, thickness of intrusive sheet, or radially in a plug; and (3) the mechanics of sampling. For the latter, whether using the block or drill method, it is preferable to determine sample orientation from observation of the Sun or of terrestrial objects rather than by using a magnetic compass. Precision of orientation is higher for a drilled core than for a block.—VSN

02518 **Graham, John W.** Preliminary account of a refined technique for magnetic susceptibility anisotropy measurement of rocks, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon

Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 409–424, illus., 1967.

Procedures are given for constructing an instrument capable of measuring without difficulty and quickly the magnetic susceptibility anisotropy of rock specimens at the 10^{-8} Gauss Oe^{-1} level. A 3,000 c/sec alternating magnetic field of 1 Oe R.M.S. is employed, and results are recorded automatically.—Author's summary

02527 **Graham, John W.** Preliminary evaluation of a new resonance magnetometer, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 96–99, illus., 1967.

The value of a new resonance magnetometer may be restricted to automatic measurement of relatively strongly magnetized core samples. Although the resonance feature is very effective with signals ≥ Brownian-noise deflections, it is of no use with weaker signals. The performance of the magnetometer could be improved by adding damping so that long-time integration systems could be exploited.—LLP

02607 **Grantz, Arthur.** Strike-slip faults in Alaska [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3564B, 1967.

Graves, M. L. *See* Lovering, T. G. 02479

02558 **Gray, Donald Harford.** Coupled flow phenomena in clay-water systems [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3924B–3925B, 1967.

02853 **Gray, Robert S.** Petrography of the upper Cenozoic non-marine sediments in the San Pedro Valley, Arizona: Jour. Sed. Petrology, v. 37, no. 3, p. 774–789, illus., tables, 1967.

The geographically restricted sediments of at least 1,000-ft thickness designated as the St. David Formation form three stratigraphic divisions: (lower) red beds characterized by red clay and mudstone with minor sand lenses; (middle and most fossiliferous) red clay and mudstone interbedded with white chalky fresh-water micritic limestones, green clays, brown silts and light-gray pyroclastic units; and (upper) brown or tan to orange silts, clays and fine sands divided by paleosols and caliche zones. The St. David is overlain by coarse granite wash. Evidence suggests that the sediments were deposited in a fluvial-lacustrine environment which existed in a subsiding Pliocene-Pleistocene valley similar to the present San Pedro Valley. Structural deformation was minor. There is no evidence of local volcanism.—RAC

02682 **Green, H. W., 2d.** Quartz—Extreme preferred orientation produced by annealing: Science, v. 157, no. 3795, p. 1444–1446, illus., 1967.

Annealing of samples of flint under high pressure, after hot-working in the β-quartz stability field, produced an exceedingly strong concentration of c-axes parallel to the direction of compression. A specimen deformed under identical conditions, but not annealed, exhibited a much weaker orientation. The strength of the annealed orientation rivals that of the remarkable "cube texture" produced by annealing some face-centered cubic metals after extreme reduction by rolling.—Author's abstract

Greene, Robert C. *See* Walker, George W. 02740

02484 **Greenland, L. Paul.** Determination of phosphorus in silicate rocks by neutron activation, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C137–C140, table, 1967.

Phosphorus has been determined in eight U.S. Geological Survey standard rock reference samples by neutron activation. After a 2-hour irradiation of 10-mg samples, phosphorus is separated in a radiochemically pure form by cation exchange, molybdate precipitation, magnesia precipitation, and CuS scavenging. A final magnesia precipitation yields phosphorus in a form suitable for low-level β^- counting. Subsequently, the percentage of recovery for phosphorus is determined

spectrophotometrically as the yellow molybdovanadophosphoric acid. The results found by this technique are in good agreement with conventional chemical analyses.—Author's abstract

03017 **Griffiths, John C.** Unit regional value concept and its application to Kansas [abs.]: Shale Shaker, v. 18, no. 1, p. 13, 1967.

Griggs, D. T. *See* Wenk, H. R. 02683

02485 **Grimaldi, F. S.; Schnepfe, Marian M.** Determination of palladium in the parts-per-billion range in rocks, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C141-C144, table, 1967.

Acid soluble palladium in rocks is determined spectrophotometrically with p nitrosodimethylaniline after its separation by coprecipitation with a small amount of tellurium formed by reduction of tellurite with stannous chloride. The ignition temperature of the tellurium precipitate is critical, because of apparent low recoveries of palladium above 400°C. Higher ignition temperatures can be used, but the tellurium precipitation with palladium must then be made in the presence of microgram amounts of platinum. Palladium contents of 2.5 ppb in reference sample G-1 and 9.0 ppb in W-1 were found. Data for reference sample W-1 suggest that aqua-regia soluble palladium may well represent the total palladium in rocks. Detailed data are given on the behavior of other noble metals.—Authors' abstract

02867 **Gross, M. Grant; McManus, Dean A.; Ling, Hsin-Yi.** Continental shelf sediment, northwestern United States: Jour. Sed. Petrology, v. 37, no. 3, p. 790-795, illus., tables, 1967.

The Columbia River is the dominant sediment source for the continental shelf near the northwestern United States. On the Washington continental shelf, modern sediment moves generally northward from the river mouth. Sand generally occurs at depths less than 90 m. Coarse silt occurs in deeper water. The modern sediments generally contain less than 1.5 percent $CaCO_3$ and less than one percent organic carbon. Relict sediments off southern Vancouver Island and along the seaward margin of the continental shelf off southern Washington and northern Oregon exhibit complex grain-size distribution and, in general, contain more organic carbon and calcium carbonate than the modern sediment.—*from* Authors' abstract

02899 **Gross, M. Grant.** Concentrations of minor elements in diatomaceous sediments of a stagnant fjord, *in* Estuaries (edited by George H. Lauff): Am. Assoc. Adv. Sci. Pub. 83, p. 273-282, illus., tables, 1967.

The marine sediments of Saanich Inlet, British Columbia, are the result of deposition in a sedimentary environment formed by an isolated part of an estuarine system, the Strait of Georgia. In these sediments, of which diatom frustules are a major component, the minor elements Sc, Y, Ti, Zr, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, and Pb are primarily associated with the lithogenous constituents. For the most part they are not abundant in the biogenous constituents, so that addition of diatoms to the sediments reduces the element concentrations. Mo is added in sufficient quantities in the central basin sediments to change the concentrations. Coprecipitation by iron sulfides may be involved in removing Mo from sea water near the water-sediment interface.—GDC

Groves, H. Leon, Jr. *See* Raup, Omer B. 02467

Gude, Arthur J., 3d. *See* Raup, Omer B. 02467

02906 **Guillet, G. R.** Notes on zinc-lead mineralization in Silurian dolomite of the Niagara escarpment and Bruce Peninsula, Ontario: Ontario Dept. Mines Misc. Paper MP-8, 17 p., tables, 1967.

In response to public interest in recent announcements concerning zinc mineralization on the Bruce Peninsula, these notes were extracted from various sources pertaining to the widespread occurrence of sphalerite and galena in Paleozoic rocks. Although not proven extensive, the Ontario occurrences are essentially similar

to the important deposits of the Mississippi Valley, U.S.A., and Pine Point, N.W.T. South-central and southwestern Ontario are underlain by Cambrian to Mississippian rocks, of which the Silurian dolomites of the Guelph–Lockport–Amabel Formations form the caprock of the Niagara escarpment. In this belt traces of sphalerite and galena replace fossils and fill minute fractures and vugs, their origin generally related to reefal circulating waters.—GDC

02637 **Güven, Necip; Burnham, Charles W.** The crystal structure of 3T muscovite: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 290–293, tables, 1967.

The crystal structure of 3T muscovite, the first structure of a mica complex consisting of more than two layers is given in detail. By comparing it with the well-refined structure of $2M_1$ muscovite, the answer is sought to the question of whether these two muscovite modifications are "polytypes" or not, that is, do they possess truly equivalent single layers. Conclusions are: (1) the single layer of $2M_1$ has $C\bar{1}$ symmetry, whereas the single layer of 3T muscovite possesses $C2$ symmetry; and (2) there is partial ordering in both tetrahedral and octahedral sites of 3T, whereas both sites are completely disordered in $2M_1$. The concept of polytypism cannot be applied to the structures of these two muscovites; rather they must be considered as polymorphs.—MST

Hails, John R. *See* Hoyt, John H. 02844

02833 **Haimson, Bezalel; Fairhurst, Charles.** Initiation and extension of hydraulic fractures in rocks: Soc. Petroleum Engineers Jour., v. 7, no. 3, p. 310–318, illus., 1967.

A criterion is proposed for the initiation of vertical hydraulic fracturing taking into consideration the three stress fields arising from: non-hydrostatic regional stresses in earth, difference between fluid pressure in the wellbore and in the formation, and radial fluid flow through porous rock from the wellbore. The wellbore fluid pressure required to initiate a fracture is a function of the porous elastic constants of the rock, the two unequal horizontal principal regional stresses, the tensile strength of the rock and the formation fluid pressure. A constant injection rate will extend the fracture to a point where equilibrium is reached and then, to keep the fracture open, the pressure required is a function of the porous elastic constants of the rock, the component of the regional stress normal to the plane of the fracture, the formation fluid pressure and the dimensions of the crack.—*from* Authors' abstract

02894 **Halbouty, Michel T.** Salt domes—Gulf region, United States and Mexico: Houston, Tex., Gulf Publishing Co., 425 p., illus., tables, 1967.

The fundamentals of salt dome geology are reviewed, including both new ideas and ideas of many previous writers. The nine chapters are: introduction, evaporite deposition in the Gulf region, origin and growth of salt structures, configuration and composition, classification of salt structures, accumulation of gas and oil, factors affecting quantity of accumulation, economic significance of salt structures, and salt dome drilling and production problems. The remainder of the book (262 p.) includes salt maps and field data of 11 salt domes, bibliographies and salt dome indices, bibliographies arranged according to author and to subject matter, and separate listings of salt domes in Texas, Louisiana, Mississippi, Alabama, and Mexico.—LLP

02668 **Hales, A. L.; Nation, J. B.; Helsley, C. E.** The Gulf Coast Onshore Offshore Experiment—Some preliminary results: Am. Geophys. Union Trans., v. 48, no. 2, p. 753–756, illus., 1967.

The purpose of the Gulf Coast Onshore–Offshore Exploration Experiment was to determine crustal structure of a section across the Gulf Coast geosyncline where the sediments are near maximum thickness. The layout of the experiment is described briefly, and some curious features of the preliminary results are noted. The irregular amplitude pattern requires some refraction effect from structures in the sediments on the shelf. The sediment thickness is clearly of the order of 20 km. Intercept times of mantle arrivals are greater than any so far published.—DBV

Hales, A. L. *See* Doyle, H. A. 03005

02439 **Hamilton, Edwin L.** Marine geology of abyssal plains in the Gulf of Alaska: Jour. Geophys. Research, v. 72, no. 16, p. 4189–4213, illus., tables, 1967.

Results of acoustic reflection profiling in the Gulf of Alaska, presented in some detail, lead to the conclusion that the East Pacific rise in the Gulf of Alaska is in an advanced stage of rise evolution, and that the whole area has been quiescent since Middle Tertiary.—DBV

02715 **Hansen, Edward; Scott, William H.; Stanley, Rolfe S.** Reconnaissance of slip-line orientations in parts of three mountain chains: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 406–410, illus., 1967.

During the course of detailed structural studies in two areas in the metamorphic core of the Norwegian Caledonides, surprising solutions were obtained for the orientations of slip lines related to the formation of large recumbent nappes. The slip lines have shallow longitudinal attitudes rather than the vertical or transverse ones predicted from current models of the nappe development in this orogenic environment. Slip-line orientations were examined, therefore, on a reconnaissance scale throughout a large portion of the Caledonides, as well as parts of the Alps and Appalachians, to determine the common slip-line orientations in various tectonic zones of the alpine-type mountain chains.—MST

02737 **Hansen, Edward.** Methods of deducing slip-line orientations from the geometry of folds: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 387–405, illus., 1967.

Several methods for orienting slip lines from the geometry of superposed slip folds are described, as a result of the study of a medium-grade metamorphic terrane at Trollheimen, Norway. The method employs interference structures in the form of domes, saddles, and basins that result when an early set of folds is refolded by slip along planes transverse to the early fold axes.—MST

02593 **Hanson, Ronald L.** Characteristics of summer base flow of the Potomac River, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C212–C215, illus., 1967.

A relation defining the rate of depletion of summer base flow during periods of negligible precipitation, and a relation expressing the monthly increase in summer base flow due to precipitation have been defined for a virtually unregulated stream. Testing these relations in a combined form using known values of monthly precipitation gives reasonable estimates of summer base flow for subsequent 1- to 4-month periods. A poor correlation was found to exist between monthly precipitation and corresponding increase in base flow. Consideration of variations in monthly evapotranspiration rates and antecedent ground-water conditions should help to explain much of the scatter in this relation; however, additional ground-water data are needed in the basin before a significant improvement in this relation can be expected.—Author's abstract

02608 **Harbour, Jerry.** Stratigraphy and sedimentology of the upper Safford basin sediments [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3564B, 1967.

Hardy, Ronald G. *See* Kansas Geological Survey. 02963

Hare, P. E. *See* Abelson, P. H. 02718

02732 **Hare, P. E.; Mitterer, R. M.** Nonprotein amino acids in fossil shells: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 362–364, table, 1967.

Analysis of a series of fossil *Mercenaria* shells has yielded some amino acids not normally found in proteins. Although the allo form of isoleucine is not present in the shell protein of a living animal, it is found in increasing amounts relative to isoleucine in progressively older fossils. In the 1,000-year-old shell the ratio of allo to isoleucine is 0.15, whereas in an upper Pleistocene specimen (C-14

age>40,000 years) the ratio is 0.53. A study of the nonprotein amino acids may provide some clues to the rate and mechanism of breakdown of proteins in shells under natural conditions, and may make it possible to predict quantitatively the rate of reaction and possible environmental conditions.—MST

02733 **Hare, P. E.** Amino acid composition of the extrapallial fluid in mollusks: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 364–365, table, 1967.

A comparison of the amino acid composition of the soluble protein in the extrapallial fluid from a living mollusk, *Mercenaria*, with that of the largely insoluble organic matrix of the shell reveals both remarkable similarities and significant differences. The relative proportions are similar for most of the amino acids except for histidine, which makes up about 25 percent of the total amino acids in the extrapallial fluid but less than one percent of the organic matrix of the shell. The relative amounts of other amino acids are reported.—MST

Harington, C. R. *See* Porsild, A. E. 02944

02609 **Harlan, Ronald Wade.** A clay mineral study of Recent and Pleistocene sediments from the Sigsbee Deep, Gulf of Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3564B—3565B, 1967.

03024 **Harris, John F.** Some interesting aspects of carbonate oil accumulation in the Mid-Continent area [abs.]: Shale Shaker, v. 18, no. 1, p. 14, 1967.

Hart, S. R. *See* Davis, G. L. 02736

02985 **Hartmann, William K.** Secondary volcanic impact craters at Kapoho, Hawaii and comparisons with the lunar surface: Icarus, v. 7, no. 1, p. 66–75, illus., 1967.

Craters formed by impacts of volcanic ejecta were studied both on aerial photographs and on the ground. The following relations are determined: (1) frequency distribution of crater diameters, (2) mass-diameter relations, and from these (3) frequency distribution of volcano ejecta masses. The latter differs from that found among lunar surface fragments (Surveyor I), which resembles that caused by simple low-energy fragmentation; it is closer to that caused by repeated, multiple fragmentation. Mass distributions of other classes of objects are briefly discussed. The terrain of the Kapoho craters superficially resembles the lunar landscape. At metric dimensions on the lunar surface, simple fragmentation has acted, and secondary (meteoritic) craters similar to those at Kapoho may exist.—Author's abstract

02705 **Hartshorn, Joseph H.; Koteff, Carl.** Geologic map of the Springfield South quadrangle, Hampden County, Massachusetts, and Hartford and Tolland Counties, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-678, scale 1:24,000, section, separate text, 1967.

The Springfield South quadrangle, in the Connecticut Valley lowland, is underlain by Triassic conglomerate, sandstone, shale, and both extrusive and intrusive basalts. The north-south lowland is about 95 mi. long and 20 mi. wide. Topography was a dominant factor in controlling glacial retreat and formation of the proglacial lake that occupied the Triassic lowland. Portland Arkose (Late Triassic), the only bedrock unit mapped, is chiefly sandstone, siltstone, shale, and minor amounts of conglomerate; it is assumed a minimum of 8,000 feet underlies the quadrangle. Glacial history and features are described in some detail. Economic resources are Portland Arkose ("brownstone"), till, clays, and sand and gravel.—MCM

02451 **Hayes, Miles O.** Relationship between coastal climate and bottom sediment type on the inner continental shelf: Marine Geology, v. 5, no. 2, p. 111–132, illus., tables, 1967.

The following correlations exist on the shelf at <200 feet depth: Mud is most abundant off humid tropic areas; sand is everywhere abundant with a maximum in zones of moderate temperature and rainfall and in all arid areas unless extremely cold; coral is most common off high-temperature areas, and gravel off low

temperature; rock correlates more strongly with inner shelf slope, but is more abundant in cold areas; and shell distribution is not diagnostic of climate. Climatic factors responsible for these patterns are: weathering at the source, the presence or absence of major rivers, and glaciation and ice-rafting. The role of relict Pleistocene sediments is also of great importance.—*from* Author's summary

02660 **Hays, James Fred.** Lime-alumina-silica: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 234-239, illus., table, 1967.

Pressure-temperature curves have been determined for several subsolidus reactions involving the phases grossular and $CaAl_2SiO_6$ pyroxene, which were not encountered in work at atmospheric pressure. Quenching runs 1 to 12 hours in length were made with the single-stage apparatus of Boyd and England. The results are presented in a series of diagrams.—MST

02509 **Hazen, Scott W., Jr.** Some statistical techniques for analyzing mine and mineral-deposit sample and assay data: U.S. Bur. Mines Bull. 621, 223 p., illus., tables, 1967.

A comprehensive summary is presented of results of several years of research at the Bureau of Mines Research Center at Denver on adapting and applying techniques of statistical analysis in mine and mineral-deposit sampling and in computing grade and tonnage of ore for a mineral deposit. In addition to elementary statistical theory the material presented in the bulletin includes: (1) certain special statistical techniques that have been found useful in mining applications; (2) problems, implications, and limitations that may be encountered in applying these techniques in mine sampling and evaluation; and (3) numerous examples to demonstrate application of the theory and techniques.—Author's abstract

02956 **Hazen, Scott W., Jr.** Ore reserve calculations, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 138-151, illus., tables, 1967.

Various methods of calculating ore reserves and their inherent problems are discussed. Examples of the use of statistical techniques to increase the amount of information on reserves include mean-square frequency distribution models, and skewness tests; and quadratic regression for trend, thickness, and grade of ore. Geometric methods, developed primarily to calculate tonnage rather than grade, are not realistic for complex orebodies. Much of the inadequacy in using mathematical-statistical models is not in the techniques, but in the lack of measurement of pertinent data during exploration. More work remains to be done in analyzing and testing exploration data to determine kinds of data essential for accurate estimation of ore grade for all minerals, metallic or nonmetallic.—GDC

Hazzard, Roy T. *See* Maxwell, Ross A. 02908

Hazzard, Roy T. *See* Maxwell, Ross A. 02910

02989 **Heatwole, Harold; MacKenzie, Faustino.** Herpetogeography of Puerto Rico—[Pt.] 4, Paleogeography, faunal similarity and endemism: Evolution, v. 21, no. 3, p. 429-438, illus., table, 1967.

A paleogeographic map of the Puerto Rican island shelf indicates that some of the small islands became isolated from each other before the Pleistocene, others were separated 8,000 to 10,000 years B.P., and still others maintained their connections until 6,000 to 8,000 years B.P. Islands which have been separated a long time have lower faunal similarities with each other and have a higher degree of endemism (unless interisland distances are extremely short) than do those which have been more recently connected. There is an inverse relationship between faunal similarity and interisland distance. Puerto Rico has a high degree of endemism despite the presence of numerous nearby islands. This is probably due to its greater size and ecological diversity. Gene flow via animals transported by flotsam has probably been predominantly from east to west.—Authors' summary

02905 **Hedges, James A.** Geology of Dutton's Cave, Fayette County, Iowa: Natl. Speleol. Soc. Bull., v. 29, no. 3, p. 73–90, illus., 1967.

Dutton's Cave, in the outcropping Edgewood limestone of the Niagara escarpment, is a Pleistocene shallow-phreatic cavern of modest size. A vertical shaft, similar to those of the Central Kentucky Karst region, possesses a cherty limestone rather than a sandstone caprock. The valley of Dutton's Cave stream includes: the broad upland indentation of the plateau above and beyond the cave, the narrow retreatal gorge into which the cave opens, and the less confined valley below the foot of the gorge. A retreat by the entrances of Dutton's and other similar caves of about 200 feet since Iowan time is indicated by the lengths of the gorges. The West Union Talus, a morphostratigraphic unit, occupies deeper parts of the gorge, underlies Iowan terrace materials in the lower valleys, and clothes their sides.—GDC

Heezen, B. C. *See* Glass, B. P. 02687

Heezen, Bruce C. *See* Lowrie, Allen, Jr. 02685

Heezen, Bruce C. *See* Johnson, G. Leonard. 02792

02624 **Heinrichs, Donald Frederick.** Paleomagnetism of the Plio-Pleistocene Lousetown formation, Virginia City, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3575B, 1967.

Helsley, C. E. *See* Hales, A. L. 02668

02525 **Helsley, Charles E.** Advantages of field-drilling of samples for palaeomagnetic studies, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 26–30, illus., table, 1967.

The advantages of the field-drilling method are the accuracy, convenience, and rapidity of the method for obtaining samples for palaeomagnetic studies. It also allows virtually any material to be sampled, reducing the amount of bias present.—LLP

02529 **Helsley, Charles E.** Design of spinner magnetometers, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 115–118, illus., 1967.

Various types of spinner magnetometers differ principally in the means of rotating the rock specimen and in the type of electronic circuitry used to measure phase and amplitude of the signal. Although techniques differ, all good spinners approach the same limit of sensitivity.—LLP

02530 **Helsley, Charles E.** Design of a transistorized portable air-turbine spinner magnetometer, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 142–148, 1967.

A portable air powered spinner magnetometer incorporating all solid-state circuitry has been designed and built and has been used in several field and laboratory studies for the past two years without major difficulties. Minimum operating sensitivity is about $1 \cdot 10^{-7}$ Gauss in the field and seems to be limited by sample-holder noise. Since band-pass filters are not used the laboratory sensitivity is somewhat less due to the relatively high residual signals derived from the harmonics of the 60-cycle power required for the other electrical equipment in the laboratory.—Author's summary

02826 **Hem, J. D.; Roberson, C. E.** Form and stability of aluminum hydroxide complexes in dilute solution: U.S. Geol. Survey Water-Supply Paper 1827-A, p. A1–A55, illus., tables, 1967.

Laboratory studies were conducted to obtain information as to the probable behavior of aluminum in natural water. When solutions were brought to pH 7.5–9.5 and allowed to stand for 24 hours, a precipitate was obtained which was virtually amorphous, had a solubility equivalent to that of boehmite, and a hydrolysis constant of 1.93×10^{-13}. When the solutions were allowed to stand for 10 days, precipitates gave the X-ray pattern of bayerite. Below neutral pH dissolved aluminum species consist of octahedral units. From kinetic experiments and stoichiometric data from solutions aged for long periods, activities of unpolymerized aluminum were determined. When polymerization was observed, it did not stop with small polynuclear complexes, but proceeded until macromolecules or colloidal-sized particles were formed.—*from* Authors' abstract

02424 **Henderson, Bonnie C.** Enrollment in earth science—Demand and supply: Geotimes, v. 12, no. 7, p. 15–16, illus., table, 1967.

Not enough students are being graduated to meed demands from industry and teaching institutions for geophysics graduates and geological engineers. The 1967 report shows 245 fewer PhD's in their degree year than in 1965. An increase of 665 junior and senior majors brings the supply back up to the 1961 level. The number of people studying geology in the U.S. for noncareer reasons has more than doubled since the count of nonmajor undergraduates was begun eight years ago; this large group of 108,000 does not include registration in junior colleges. It may reflect in part the success of high-school earth science courses and points again to an increased need for teachers. Data are included for Canada and for the fields of oceanography, geological engineering, and earth science teaching.—MCM

Henderson, E. P. *See* Brett, Robin. 02907

Henry, V. J. *See* Eddy, J. E. 02472

Heyward, Henry H. *See* Feulner, Alvin J. 02590

Hill, Ronald R. *See* Bara, John P. 02708

02744 **Hillis, S. F.; Skermer, N. A.** Discussion [of "Static and seismic behaviour of an earth dam," by W. D. L. Finn, 1967], *in* Papers presented at the 19th Canadian Soil Mechanics Conference, Pt. 1: Canadian Geotech. Jour., v. 4, no. 1, p. 39–42, illus., 1967.

Some of the limitations of the finite element method (Finn, ibid., p. 28–37) for both static and dynamic analysis are presented. Points discussed are plane strain, laboratory tests, Poisson's ratio, water load, and slip. The authors have used the method in connection with the design of Mica Dam.—ESL

Hills, L. V. *See* Agterberg, F. P. 02832

Hines, Marion S. *See* Albin, Donald R. 02827

02690 **Hite, Robert J.; Dyni, John R.** Potential resources of dawsonite and nahcolite in the Piceance Creek basin, northwest Colorado, *in* Symposium on Oil Shale, 4th: Colorado School Mines Quart., v. 62, no. 3, p. 25–38, illus., 1967.

Large quantities of dawsonite, nahcolite, halite, and other sodium minerals were discovered in a saline facies of the Parachute Creek Member of the Eocene Green River Formation, during recent core drilling. Data from one drill hole indicate that dawsonitic aluminum in one square mile exceeds that in the total bauxite reserves of the United States. An interval of dawsonite-bearing oil shale is 628 feet thick and averages 10.7 percent dawsonite. In this interval, rocks nearly 300 feet thick average 2.3 percent acid-extractable aluminum. The richest zone is 18 feet thick and averages 3.9 percent aluminum. In the same core hole, the dawsonite zone is nahcolite-bearing through two intervals that total 468 feet and average 15.5 percent nahcolite. Dawsonite and nahcolite constitute potentially valuable sources of aluminum and soda ash, respectively, which may be recoverable by-products of spent shale from oil-shale retorts.—ESL

02974 **Hoare, Richard D.** Discussion of fauna [of the Sunflower Formation], *in* Geology of the Mount Velma quadrangle, Elko County, Nevada: Nevada Bur. Mines Bull. 68, p. 11–12, 1967.

Fusilinids from the Sunflower Formation include species of *Pseudofusulina*, known only from the Permian, and species of *Pseudofusulinella*, known from Permian and Upper Pennsylvanian. The corals contain several forms that indicate a Permian age, and the bryozoans have a Pennsylvanian–Permian appearance. Although brachiopods are poorly preserved, some identification was possible. On the basis of the fauna, the Sunflower Formation is believed to be lowermost Permian (Wolfcampian). The fauna is unlike other Permian faunas in the southwestern U.S., and appears to have Asiatic affinities.—LLP

02774 **Hodgson, G. W.; Baker, B. L.; Peake, E.** Geochemistry of porphyrins, Chap. 5 *in* Fundamental aspects of petroleum geochemistry (B. Nagy and U. Colombo, editors): Amsterdam and New York, Elsevier Publishing Co., p. 177–259, illus., tables, 1967.

The distinctive porphyrins compounds in petroleum offer some hope of defining more clearly the genesis of petroleum. In this chapter, the current knowledge of petroleum porphyrins is reviewed in terms of their structure, properties, origin, and natural occurrence in relation to the geochemistry of petroleum. There are four basic spectral types of porphyrin structures that occur in petroleum. Evidence is strong that petroleum porphyrin pigments come from a variety of chlorophyll and hemin-like compounds in living organisms which, after undergoing significant changes in properties by metal complex exchange reactions, may play a surfactant role in the mobilization, migration, and accumulation of crude oil hydrocarbons.—GDC

02813 **Hodych, J. P.** A two-component magnetometer used to measure magnetization changes of rock under uniaxial compression, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 593–595, illus., 1967.

An astatic magnet system and a parastatic magnet system were used together in a novel configuration which reduced the interaction between the two systems, thus allowing magnetization changes to be measured along two axes of a fixed sample at the same time. This two-component magnetometer was designed and used to measure stress-induced magnetization changes both along and perpendicular to the axis of compression of a rock sample.—Author's summary

Hoering, T. C. *See* Abelson, P. H. 02731

02734 **Hoering, T. C.** Criteria for suitable rocks in Precambrian organic geochemistry: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 365–372, illus., tables, 1967.

Successful study of the organic geochemistry of Precambrian rocks requires well-preserved material with sufficient indigenous organic chemicals. Hoering describes experiments designed to guide the discovery of such rocks. Criteria are proposed for deciding whether organic molecules are indigenous. Some possible sources of contamination are identified.—MST

02512 **Hoffmeister, J. Edward.** The present—A clue to the past: Sea Frontiers, v. 13, no. 4, p. 218–225, illus., 1967.

Study of the geology of the southern tip of Florida is used as an illustration of the concept that oceanography is one of the best contributors to the study of geology. The Pleistocene Miami Limestone, which covers the area, has an oolitic and a bryozoan facies. The cross-bedded oolite forms the Atlantic Coastal Ridge, while the Everglades to the west is underlain by the bryozoan facies. On the Great Bahama Bank, across the Straits of Florida, a bar of loose oolite sand is forming east of the cays. Water over it is so shallow that currents create cross bedding in the growing bar. In the shallow lagoon east of the bar bryozoans are growing, the same species as those from the Everglades. These two environments are mirror images; conditions

producing the Bahamian half must be the same as those operating over the southern tip of Florida 100,000 yr ago.—ESL

02751 **Hogberg, R. K.; Bayer, T. N.** Guide to the caves of Minnesota: Minnesota Geol. Survey Educ. Ser. 4, 61 p., illus., 1967.

An introductory section discusses caves in general and defines some of the terms. Minnesota's caves are scattered through a 1,500–1,600-ft sequence of Paleozoic rocks cropping out in the valley walls of the Mississippi River in the southeastern part of the State. Discussion of their development is divided into limestone and sandstone caves, with those along the gorge in the St. Anthony Falls–Fort Snelling area as examples of the latter. Limestone caves are mostly in the Galena and Dubuque Formations, sandstone caves in the St. Peter, and all probably formed in the latter part of the Pleistocene. Detailed descriptions are given of Mystery and Niagara, commercial limestone caves, and brief descriptions of several sandstone caves.—ESL

02829 **Holsinger, John R.** Systematics, speciation, and distribution of the subterranean amphipod genus *Stygonectes* (Gammaridae): U.S. Natl. Mus. Bull. 259, 176 p., illus., tables, 1967.

Taxonomy of the Recent malacostracan genus *Stygonectes* is revised, and its evolution from marine ancestors is traced backward by distribution patterns of extant fresh-water forms, which are confined to parts of eastern and south-central U.S. Combined ranges of the 29 species form a geographic pattern that corresponds rather closely to the Late Cretaceous shoreline of the Coastal Plain. The most feasible time for invasion was during Eocene or Miocene; subsequent inland dispersal was along flood plains of major rivers. Three major lines of evolutionary divergence are recognized. The species occupy ground-water biotopes of two types: caves and solution channels in limestone regions, interstitial habitats in areas of noncavernous rocks. Patterns of dispersal and insular speciation are interpreted in the light of paleogeography, rock types, faults, and subsurface drainage.—VMJ

02610 **Holstrom, Geoffrey Burwell.** Elastic radiation from a propagating phase boundary [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3565B, 1967.

02933 **Hook, Roger LeB.** Processes on arid-region alluvial fans: Jour. Geology, v. 75, no. 4, p. 438–460, illus., tables, 1967.

Debris flows deposit most material in upper parts of arid-region alluvial fans. Water-flow channels are incised into debris flow deposits near a fanhead, but emerge onto the fan surface near a midfan point; fluvial deposition predominates lower on the fan. Where fine material is sparse, masses similar to debris flows are halted by infiltration of water into underlying material. These different agents of deposition are reflected by differences in morphology and lithology of deposits.—DRM

Hopkins, D. M. *See* Péwé, T. L. 02459

02418 **Hopkins, David M.** (editor). The Bering Land Bridge: Stanford, Calif., Stanford Univ. Press, 495 p., illus., tables, 1967.

The book is an outgrowth from the INQUA Land Bridge Symposium. Eight of the 24 essays included were not given at the symposium, and two of the papers read there are not included in the book. Disciplines represented are geology; molluscan, vertebrate, and micropaleontology; geophysics; oceanography; geochronology; botany; cytology; paleobotany; palynology; physical anthropology; and archeology. Sixteen papers are cited separately.—ESL

02454 **Hopkins, David M.** Quaternary marine transgressions in Alaska, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 47–90, illus., tables, 1967.

Nine intervals when sea level stood high enough to flood Bering Strait are recorded in western Alaska by late Pliocene to Recent deposits. They can be correlated with a less complete sequence in Siberia. Most deposits of the Beringian transgression,

Pliocene–Pleistocene, are probably older than the first continental glaciation. The Anvillian deposits cannot be related to recognized glacial–interglacial events, but other transgressions correspond to interglacials in the United States and Europe. The Beringian transgression and the late Pleistocene Pelukian are complex, each including at least two high sea levels. Highest level was probably in the middle Pleistocene Anvillian, with lower than present during the middle Wisconsin transgression, but high enough for the Strait to exist. Transarctic migrations are indicated by appearances of Atlantic mollusks in Alaska during several transgressions.—ESL

Hostetler, Paul B. *See* Christ, C. L. 02477

02725 **Hotz, P. E.** Geologic map of the Condrey Mountain quadrangle, and parts of the Seiad Valley and Hornbrook quadrangles, California: U.S. Geol. Survey Geol. Quad. Map GQ–618, scale 1:62,500, sections, 1967.

The map sheet includes inset maps showing the geology of the central and southern Klamath Mountains, and interpretation of the geologic structure and metamorphic zones of the Condrey Mountain quadrangle. A table indicates mineral variations with increasing metamorphism.—MCM

02816 **Howard, Alan D.; Howard, Barbara Y.** Solutions of limestone under laminar flow between parallel boundaries: Caves and Karst, v. 9, no. 4, p. 25–40, illus., tables, 1967.

Experiments investigating solution kinetics in carbonate rocks under conditions approaching those of natural ground-water flow through joints and fissures are reported. Because the experiments represented the initial stage of solution enlargement of fractures and joints into caves and fissures, flow was restricted within parallel walls of limestone with narrow gaps. Two types of calcium carbonate were used: a very pure crystalline limestone, the "Tennessee Marble" of the Holston and Lenoir Formations, and a pure, black, organic-rich limestone from the Stone River Formation.—LLP

Howard, Barbara Y. *See* Howard, Alan D. 02816

02611 **Howard, James Franklin.** Biostratigraphy and paleoecology of the Duplin (late Miocene) and Waccamaw (Pliocene?) Formations of North and South Carolina [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3565B–3566B, 1967.

02679 **Howard, Richard H.** Oil and gas pay maps of Illinois: Illinois Geol. Survey Illinois Petroleum 84, 64 p., illus., 1967.

Twenty-one reasonably well-recognized zones in the Illinois geologic column ranging in age from Pennsylvanian to Ordovician have produced oil and/or gas during the last 80 years. The oil and gas pay maps in this report show the approximate real extent of production from these zones.—Author's abstract

Hoyt, John. *See* Eddy, J. E. 02472

02814 **Hoyt, John H.** Intercontinental correlation of late Pleistocene sea levels: Nature, v. 215, no. 5101, p. 612–614, illus., 1967.

Late Pleistocene shorelines of coastal Georgia are compared with those of southern South-West Africa. The elevation of the shorelines are essentially similar, suggesting a general stability of the two areas during and since their development.—DBV

02844 **Hoyt, John H.; Hails, John R.** Significance of radiocarbon dates from Botany Bay Island, South Carolina: South Carolina Div. Geology Geol. Notes, v. 10, no. 4, p. 61–65, illus., 1967.

Marine shells above normal high tide level can be explained in several ways: (1) deposition during brief periods of high water associated with hurricanes and storms, (2) slightly higher Holocene sea levels, (3) wind deposition, and (4) Indian middens. Examination of shell layers as high as 2.5 to 3.5 feet above mean high tide at Botany

Bay Island, S. C., and Cabretta and Sapelo Island, Ga., indicates that these shells were deposited by high water associated with periodic storms and hurricanes. Radiocarbon analyses of shells taken from the layers date the individual shells rather than the period of accumulation of the layers. Shells of different ages and several environments are strewn over these beaches and may be concentrated in layers during temporary high water.—Authors' abstract

02440 **Hsu, L. C.** Melting of fayalite up to 40 kilobars: Jour. Geophys. Research, v. 72, no. 16, p. 4235–4244, illus., table, 1967.

The melting curve of hydrothermally synthesized fayalite, Fe_2SiO_4, has been determined at pressures up to 40 kb, using single-stage piston-cylinder apparatus and Pt/Pt-10Rh thermocouples. The melting curve approximates a straight line defined by the equation $T = 1205 + 4.85P$, with T expressed in degrees Celsius and P in kilobars. The slope of the curve is only slightly steeper than that for forsterite, Mg_2SiO_4, suggesting that the nature of olivine solid solution at higher pressures might not differ appreciably from that at atmospheric pressure. Incongruent melting of fayalite persists up to at least 25 kb. The quench crystals at high pressures have essentially the same d_{130} spacing as the original crystals.—Author's abstract

02567 **Hsu, Liang-chi.** Selected phase relationships in the system Al-Mn-Fe-Si-O-H, a model for garnet equilibria [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3991B–3992B, 1967.

Huddle, John W. *See* Sandberg, Charles A. 02482

02434 **Huffman, Claude, Jr.; Mensik, J. D.; Riley, L. B.** Determination of gold in geologic materials by solvent extraction and atomic-absorption spectrometry: U.S. Geol. Survey Circ. 544, 6 p., illus., tables, 1967.

The two methods presented for the determination of traces of gold in geologic materials are the cyanide atomic-absorption method and the fire-assay atomic absorption method. In the cyanide method gold is leached with a sodium cyanide solution. The monovalent gold is then oxidized to the trivalent state and concentrated by extracting into methyl isobutyl ketone prior to estimation by atomic absorption. In the fire-assay atomic-absorption method, the gold-silver bead obtained from fire assay is dissolved in nitric and hydrochloric acids. Gold is then concentrated by extracting into methyl isobutyl ketone prior to determination by atomic absorption. By either method concentrations as low as 50 parts per billion of gold can be determined in a 15-gram sample.—Authors' abstract

02680 **Hume, James D.; Schalk, Marshall.** Shoreline processes near Barrow, Alaska—A comparison of the normal and the catastrophic: Arctic, v. 20, no. 2, p. 86–103, illus., 1967.

Studies of sediment movement between 1948 and 1962 along the Alaska coast west of Point Barrow indicate a normal average yearly net transport to the northeast of 10,000 cu yd. Net transport east of Point Barrow, based on surveys begun in 1958 indicate a normal annual southeastward movement there of 9,500 cu yd. On October 3, 1963, a storm with gusts of up to 75 mph blew over an ice-free ocean and attacked the coast. Wave heights, estimated at 10 feet combined with a storm surge of 11 to 12 feet, caused coastal flooding and over three million dollars damage. The 1963 storm, probably a "200-year storm", moved over 200,000 cubic yards of sediments which is equivalent to 20 years' normal transport. If the climate is becoming warmer, such storms can be expected more frequently. Construction adjoining the shore should be planned accordingly.—Authors' abstract

02918 **Hussey, Arthur M.; Chapman, Carleton A.; Doyle, Robert G.; Osberg, Philip H.; Pavlides, Louis; Warner, Jeffrey.** (compilers). Preliminary geologic map of Maine: Augusta, Maine, Maine Geol. Survey, scale 1:500,000, 1967.

Hutchison, Harold C. *See* Rooney, Lawrence F. 02874

02580 **Idriss, Izzat Muhammad.** Response of earth banks during earthquakes [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3506B, 1967.

02781 **Illing, V. C.** Arville Irving Levorsen [1894–1965]: Geol. Soc. London Proc. 1965–66, no. 1636, p. 203–204, 1967.

02494 **Ingamells, C. O.; Suhr, N. H.** Chemical and spectrochemical analysis of standard carbonate rocks: Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1347–1350, tables, 1967.

Chemical and spectrochemical analyses of four limestone and dolomite samples are reported. The samples were a dolomite from Woodville, Ohio, a limestone from Marble Cliff, Ohio, a limestone from Spore, Ohio, and a limestone–dolomite blend.—DBV

Ingamells, C. O. *See* Donnay, Gabrielle. 02650

02936 **Ingram, William L.** Recreation Park area of Long Beach oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1966, v. 52, no. 2, pt. 2, p. 67–72, illus., tables, 1967.

The Recreation Park area is southeast of the Old area of Long Beach field and is also on trend with several major oil fields in the Los Angeles basin which are associated with the Inglewood–Newport uplift; the structure is a very narrow, faulted anticlinal nose. Strata in the area range in age from upper Miocene to Recent. The Upper Wasem zone (Pliocene) is productive only near the northwestern limits of the area at a depth of 6,000 feet, with maximum thickness about 250 feet. The McGrath zone (Miocene) is found at a depth of 6,900 feet and has a maximum thickness of about 1,200 feet.—MCM

02430 **Ireland, H. A.** A pre–Drake oil well: Geotimes, v. 12, no. 7, p. 17–18, 1967.

A well drilled in 1818 in Wayne County, Ky., is believed to be the first well in North America to produce oil in commercial quantities although none was marketed. The well had been drilled to find brine for commercial extraction of salt, but was abandoned because of the interference of oil at 170-ft depth.—LLP

Irwin, W. P. *See* Blake, M. C., Jr. 02462

Isacks, Bryan. *See* Oliver, Jack. 02442

02970 **Ishihara, Shunso.** Molybdenum mineralization at Questa mine, New Mexico, U.S.A. [with Japanese abs.]: Japan Geol. Survey Rept. 218, 64 p., illus., tables, 1967.

Molybdenum mineralization associated with hydrothermal alteration occurs at the Questa mine on the western slope of the Taos Range. Flows, tuffs, and breccias—andesite, porphyritic-quartz latite and rhyolite in composition—are extruded on a base of Precambrian metamorphic rocks. Dikes or plugs of monzonite quartz and stocks of granite and aplite accompany the effusive rocks. The igneous activities occurred in the lower Miocene. Among these intrusives, molybdenum mineralization is largely associated with the most fractionated stock-type intrusion, the Questa Mine aplite. The deposits are along the west flank of the aplite stock, molybdenite occurring mainly in veins and fractures with quartz, sericite, and pyrite, and small amounts of biotite, carbonates, fluorite, sphalerite, chalcopyrite, and galena.—*from* Author's abstract

02568 **Isphording, Wayne Carter.** Petrology and stratigraphy of the Kirkwood Formation [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3992B, 1967.

02465 **Jackson, Everett D.; Stevens, Rollin E.; Bowen, Roger W.** A computer-based procedure for deriving mineral formulas from mineral analyses, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C23–C31, illus., tables, 1967.

The anion-based, hydrogen-equivalent method for deriving formulas from chemical analyses of minerals has been programmed in Extended Algol for the Burroughs

B5500 computer. Input data consist of the weight percentage of oxides or halogens and, if desired, the density and cell volume of the mineral. From these data the computer calculates the number of ions per formula, ratios of ions, normalized values of ions, gram-formula weight, calculated density, and(or) calculated cell volume. The program is designed to provide a maximum flexibility of output with a minimum of input data. It eliminates tedious hand calculations, reduces the chances for error, provides a standardized basis of comparison of mineral norms, and permits systematic searches for integral numbers of anions per formula or of formulas per unit cell, if these parameters are unknown.—Authors' abstract

Jackson, M. L. *See* deVilliers, J. M. 02995

Jaeger, H. *See* Boucot, A. J. 02808

James, H. B. *See* Thompson, M. C. 02996

02868 **Jaron, Michael G.** A method for determining post-depositional alteration in underclays and associated lithologies: Pennsylvania Geol. Survey, 4th ser., Inf. Circ. 57, 14 p., illus., 1967.

A detailed vertical column of samples of argillaceous and carbonate lithologies between the Upper and Lower Freeport coals was collected in a strip mine in Clearfield County, Pa. The section was divided into four units on the basis of lithology and analyzed with an X-ray diffractometer and spectrograph. The degree of illitization of muscovite (as shown by the amount of line broadening), concentrations of Ti-bearing minerals, and of limonite were determined to be criteria indicative of postdepositional alteration.—ESL

Jensen, Mead Leroy. *See* Cheney, E. S. 02716

02626 **Jinks, Douglas David.** Genesis of some clays in the Altamaha River watershed of Georgia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3616B, 1967.

02420 **Johnson, Albert W.; Packer, John G.** Distribution, ecology, and cytology of the Ogotoruk Creek flora and the history of Beringia, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 245–265, illus., tables, 1967.

Fossil evidence suggests that this flora was derived from species associated with the high-latitude Arcto-Tertiary forest; it points to the persistence of a flora, like that today, in unglaciated refugia. The area around the land bridge supported a tundra flora throughout Quaternary. The large proportion of polyploid species suggests evolution in a period of climatic and physiographic disturbance; the degree of their divergence from their parental species is a measure of relative age. Analyses of the Ogotoruk Creek–Cape Thompson flora indicate four geographic elements: oceanic, montane, arctic, and boreal; only the first two appear to have evolved under stable conditions. Bering Strait has not been an effective barrier to tundra plant dispersal. Tundra climates persisted in Beringia all during the Quaternary and probably prevented migrations of forests over the land bridge.—ESL

02720 **Johnson, G. A. L.; Johnson, H. M.** Algal pinnacles in the pluvial lakes of the Great Basin, North America [summ.]: Geol. Soc. London Proc. 1965–66, no. 1637, p. 40–42, discussion, 1967.

Johnson, G. A. L. *See* Bott, M. H. P. 02779

02792 **Johnson, G. Leonard; Heezen, Bruce C.** The Arctic Mid-Oceanic Ridge: Nature, v. 215, no. 5102, p. 724–725, illus., 1967.

The Arctic Mid-Oceanic Ridge is described in the light of recent geophysical data. This ridge does not bisect the entire Arctic Basin but lies midway between the monolithic, aseismic Lomonosov Ridge and the Eurasion continental margin. It is flanked by the Pole and Barents abyssal plains. It ends abruptly in the continental margin of Greenland, suggesting a north-northwest extension of the Spitsbergen

fracture zone. Magnetic anomalies over the ridge have very small amplitudes compared with the Mid-Atlantic Ridge but, there is a well defined pattern of linear axially oriented anomalies associated with it. Crustal growth along the present ridge has gradually separated the Lomonosov Ridge from Eurasia; Alpha Ridge may represent a former axis of crustal growth.—DBV

Johnson, H. M. *See* Johnson, G. A. L. 02720

Johnson, J. G. *See* Boucot, A. J. 02885

02987 **Johnson, Ralph Gordon.** The vertical distribution of the infauna of a sand flat: Ecology, v. 48, no. 4, p. 571–578, illus., tables, 1967.

This study is concerned with the vertical distribution of macroscopic invertebrates at two sites in Tomales Bay, Calif. Four sampling procedures were used to obtain data on more than 20,000 individuals. The infauna does not react to tidal fluctuations in water level by appreciable vertical movements in the areas studied. There is no evidence that the depth of the infauna varies with elevation in the range from 0 to 1 m above sea level. The average median depth of all species (except *Phoronopsis harmeri*) was found to be 8 cm in samples taken at low tide during daylight hours. Most species of the infauna and about 80 percent of the individuals occur in the upper 15 cm.—Author's abstract

Johnson, Robert B. *See* West, Terry R. 02965

02588 **Johnson, Ross B.** The great sand dunes of southern Colorado, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C177–C183, illus., 1967.

The Great Sand Dunes National Monument in the San Luis Valley of southern Colorado was set aside to preserve a tract of large spectacular transverse dunes. However, large areas of climbing dunes, barchans, longitudinal dunes, parabolic dunes of accumulation, and parabolic dunes of deflation also occur in and adjacent to the Monument. The geologic setting indicates that the whole area formed more or less contemporaneously; different processes, operating in different parts of the field, formed the various types. The original source areas of the sand grains were the San Juan and Sangre de Cristo Mountains that border the San Luis Valley; the immediate sources are the ancient natural levees and dry oxbow lakes of the Rio Grande.—*from* Author's abstract

02542 **Johnston, F. J.** Abram Lake area (west part), District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 421, scale 1 in. to 1/4 mi., text, 1967.

The west part of the Abram Lake area contains two belts of east-northeast-trending metavolcanics separated by a belt of metasediments about 2 1/4 miles wide near the center of the area. Granitic rocks intruding the two belts form a composite batholithic mass containing abundant xenoliths and remnants of country rock. A few gold occurrences have been uncovered as well as occurrences of pyrite and pyrrhotite that locally contain small amounts of chalcopyrite.—MCM

02991 **Kahle, Anne B.; Ball, R. H.; Vestine, E. H.** Comparison of estimates of surface fluid motions of the Earth's core for various epochs: Jour. Geophys. Research, v. 72, no. 19, p. 4917–4925, illus., 1967.

The velocity of the fluid at the surface of the Earth's core can be related to the magnetic field and its secular change at the Earth's surface through hydromagnetic equations. The method we developed previously for finding the velocity is briefly reviewed, along with a few modifications, principally the use of the secular change for a single epoch rather than for a 40-year average. The velocity patterns for epoch 1960 show an upflow in southern Africa and a downflow in the Pacific, and four horizontal rotational cells, corresponding roughly to geostrophic flow around the vertical flow. The westward drift is somewhat smaller than that found previously by others. Comparison of the velocity patterns at epochs 1885, 1912, 1933, and 1960 shows the African upflow to be a strikingly persistent feature.—Authors' abstract

Kahle, Anne B. *See* Vestine, E. H. 02992

03014 **Kane, Julius; Sadeh, Dror.** Teleseismic response of a non-uniform crust [abs.], *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 372, 1967.

02963 **Kansas Geological Survey; Kansas University; Angino, Ernest E.; Hardy, Ronald G.** (editors). A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, 183 p., illus., tables, 1967.

This forum was divided into three sessions, titled respectively: exploration and evaluation, applications of geochemistry to industrial mineral development, and practical examples of industrial mineral development. The papers are arranged in this volume in the order presented at the meeting, edited only to present a unified style and format. Fourteen papers and one abstract are cited separately. The subject matter of the Forum ranged through geochemical studies, beneficiation techniques, remote sensing, zoning statutes, product development, statistical and computer techniques, and instrumental analysis and serves to reveal and emphasize the changing character of industrial mineral studies and the importance of a new approach in education and research.—GDC

Kansas University. *See* Kansas Geological Survey. 02963

Kappel, Henry M. *See* Presley, Bob J. 02841

Kastner, Miriam. *See* Siever, Raymond. 02839

02988 **Kauffman, Erle G.** Cretaceous *Thyasira* from the Western Interior of North America: Smithsonian Misc. Colln.,v. 152, no. 1, p. 1–159, illus., tables, 1967.

The unique lucinoid *Thyasira* is represented in the Western Interior Cretaceous by 7 new species and 10 new subspecies distributed through 11 Campanian ammonite zones. The morphology, ecology, and anatomy of *Thyasira* are similar in Cretaceous and living species. Primary evolutionary trends in Cretaceous lineages are: reduction of convexity; elongation of the height (burrowing) axis; reduction of projecting flanks; and size restriction, straightening, and posterior migration of the primary sulcus. These are adaptive trends for more rapid, efficient, burrowing, or reflect anatomical modifications related to change in shell form. Cretaceous and living species show similar substrate and molluscan associations, adaptive features, and latitude distribution, and are excellent paleoecologic indicators.—*from* Author's abstract

02586 **Kaye, Clifford A.** Kaolinization of bedrock of the Boston, Massachusetts, area, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C165–C172, illus., 1967.

Foundation borings show that much of the bedrock beneath Boston and surrounding communities has been altered to a white soft clayey aggregate. Thin-section study and X-ray-diffraction analyses show that kaolinite is the major mineral formed. Siderite also occurs in the altered iron-rich igneous rocks. Intensive alteration is known to occur at depths in excess of 300 feet below the bedrock surface. The alteration is possibly hydrothermal in origin, but more probably it represents the roots of an extensive lateritic regolith that mantled southern New England in the Tertiary.—Author's abstract

02585 **Kehn, T. M.; Palmer, J. E.; Franklin, G. J.** Revised correlation of the No. 4 (Dawson Springs No. 6) coal bed, Western Kentucky coal field, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C160–C164, illus., tables, 1967.

The coal bed in the Dawson Springs area of the Western Kentucky coal field, known locally as the Dawson Springs No. 6 coal bed, lies approximately 200 feet below the No. 6 coal bed of the Carbondale Formation in the Providence–Dekoven area

and is herein designated the No. 4 coal bed of the Tradewater Formation. It has been mined extensively in the Dawson Springs and Saint Charles quadrangles for many years and is the source of high-quality stoker and coking coal. Recognition of the correct stratigraphic position of the No. 4 coal bed should aid in exploration for additional minable reserves.—Authors' abstract

02513 **Kerns, Raymond L., Jr.** Particle-size separation of clays: Oklahoma Geology Notes, v. 27, no. 9, p. 167–174, illus., tables, 1967.

The siphon and centrifugation techniques of particle-size separation of clays are described and their applications and limitations discussed. For particles ≥ 1 micron spherical diameter, separation can be accomplished by differential settling followed by decantation or siphoning. The technique utilizes differential settling velocities according to Stoke's law. For particles ≤ 1 micron, settling velocities are too slow, and separation can be more efficiently handled with high-speed centrifugation.—LLP

02871 **Kerns, Raymond L., Jr.** Clay-mineral dehydration: Oklahoma Geology Notes, v. 27, no. 8, p. 155–164, illus., table, 1967.

Weight-loss-determination techniques are quite simple compared to other types of analysis. Routine drying temperature of 105°–115°C are suitable for most clay minerals; however clays having expandable lattices with a high-magnesium interlayer cation composition cannot be completely dehydrated at temperatures below 200°C. A 32.5-percent error would have resulted from estimating the interlayer-water content of a vermiculite sample at 115°C rather than at 225°C. A thorough knowledge of the non-clay mineral composition of the sample, which might contribute to total weight loss values, is also necessary for accurate estimations. With a thorough knowledge of the material and careful experimental technique, weight-loss determinations can provide meaningful information to clay-mineral investigations.—*from* Author's conclusions

02612 **Kesler, Stephen Edward.** The geology and ore deposits of the Meme-Casseus district, Haiti [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3566B, 1967.

02597 **Keys, W. Scott.** Magnetic tape recording of geophysical logs, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C242–C246, illus., 1967.

An inexpensive magnetic tape system has been developed and used for recording geophysical well logs. The unmodified signal from a logging probe is recorded simultaneously with the conventional graphic log. During tape playback, all adjustments normally made during logging are possible. These include independent changes in horizontal scale, vertical scale, zero positioning, and time constant. Use of this system reduces the time spent at the well. Correction of operator errors and equipment malfunctions can be done in the office, and logs can be plotted at any time in a format consistent with the planned use. This system also provides for the economical storage and retrieval of data.—Author's abstract

03020 **King, Charles R.** Ordovician oil in the Sedgwick Embayment [abs.]: Shale Shaker, v. 18, no. 1, p. 13, 1967.

02828 **King, Lester C.** The morphology of the Earth—A study and synthesis of world scenery: New York, Hafner Publishing Co., 726 p., illus., tables, 1967.

This book deals with the physical features of the Earth and its evolution, principally from Mesozoic to the present. The 19 chapters include: structure of the Earth's crust; unity of Gondwanaland during the late Paleozoic and Mesozoic; continental structure; standard cycle of denudation; depositional landforms; tectonics and landscape evolution; ages of landsurfaces; geomorphology of Africa; cyclic landsurfaces in Gondwanaland; North American plainlands, cyclic landsurfaces in Europe and Asia; Paleozoic, Mesozoic, and Cenozoic mountain basin forms and features; and the Atlantic, Pacific, and Indian Ocean Basins. There are 250 figures,

maps, and plates including 3 maps (in pocket) showing the morphological features of the Atlantic, Pacific, and Indian Ocean Basins.—LLP

02600 **King, Paul Hamilton.** The movement of pesticides through soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3549B—3550B, 1967.

02753 **Kinkel, Arthur R., Jr.** The Ore Knob copper deposit, North Carolina, and other massive sulfide deposits of the Appalachians: U.S. Geol. Survey Prof. Paper 558, 58 p., illus., tables, geol. map, 1967.

The ore at Ore Knob is massive and disseminated pyrrhotite–pyrite–chalcopyrite in an essentially concordant shear and breccia zone in Precambrian quartz–muscovite paragneiss. The orebody parallels lineation and has an explored plunge length of more than 3,000 feet; 35,000 tons of copper had been produced when the mine was closed in 1962. The ore has been metamorphosed, with recrystallization of both ore and wall rock in a nonstress environment, so that present textures may have little relation to primary textures. Boudinage, dilation, and flow structures are common, and sulfides and silicate minerals appear to have mutual relations. Age determinations on hornblende and biotite suggest that the ore was deposited about one billion years ago, and was subjected to several later metamorphic events.—ARK

02587 **Kinoshita, Willie T.** May 1963 earthquakes and deformation in the Koae fault zone, Kilauea Volcano, Hawaii, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575–C, p. C173–C176, illus., 1967.

An episode of frequent earthquakes with a background of continuous harmonic tremor began at 21^h50^m on May 9, 1963. During the 4 days of this episode 3,000–4,000 earthquakes were recorded on the U.S. Geological Survey Hawaiian Volcano Observatory seismic network. The earthquakes occurred in the western half of the Koae fault system and were accompanied by abundant ground cracking. Tilt measurements on Kilauea Volcano made after the episode showed that the summit had deflated.—Author's abstract

02932 **Kirkby, M. J.** Measurement and theory of soil creep: Jour. Geology, v. 75, no. 4, p. 359–378, illus., tables, 1967.

A theoretical model of soil creep was tested in a laboratory study and by measurements on natural slopes of southwest Scotland. The most important agents of creep in Scotland are estimated to be soil moisture, freeze–thaw, burrowing animals, and temperature changes, in that order. The rate of soil wash there is significantly less than that of soil creep. Together, acting at present rates, soil creep and wash would have lowered the drainage basin an average of 1/3 inch in the last 10,000 years.—DRM

02891 **Klein, Cornelis, Jr.; Waldbaum, David R.** X–ray crystallographic properties of the cummingtonite–grunerite series: Jour. Geology, v. 75, no. 4, p. 379–392, illus., tables, 1967.

Refined lattice parameters and values of 2θ FeKα for selected reflections are used to determine mole percent $Fe_7Si_8O_{22}(OH)_2$ in the $Mg_7Si_8O_{22}(OH)_2$–$Fe_7Si_8O_{22}(OH)_2$ series. Results are shown by equations, graphs, and tables. Composition can be determined with an accuracy of ±2–3 mole percent. All possible *h k l* reflections in space group C 2/m, 2θ = 9°–81°, FeKa radiation, are listed, together with calculated values of *d* and 2θ for an intermediate member of the series. A chemical analysis of grunerite containing 59.1 mole percent Fe^{+2} member is given. The other 26 analyses to which the X–ray data are related are from the literature. Calculation of molar volumes of mixing indicates these monoclinic amphiboles are not ideal solutions.—BFL

Klement, William, Jr. *See* Cohen, Lewis H. 02426

Kneller, William A. *See* Wilband, John T. 02957

02958 **Kneller, William A.** Aggregate solubility related to chert petrographic textures and electron surface morphologies [abs.], *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 110, 1967.

02596 **Knochenmus, Darwin D.** Shoreline features as indicators of high lake levels, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C236-C241, illus., table, 1967.

A relation between certain shoreline features (tree line of the slash pine, beach scarp, beach ridge) and high lake levels was found on eight Florida lakes. For the lakes studied, the features were above the lake level an average of 95 percent of the time. An estimate of former high levels of ungaged lakes can be made from this relation. Grain-size analyses of the material comprising the various geomorphic features show a consistent relation between median diameter and the type of feature. In order of decreasing median grain size, material of the high beach ridge is followed by that of the low beach ridge, the upland, and the base of the beach scarp. This relation helps separate areas which have been under the influence of wave action from those which have been above the water level.—Author's abstract

02505 **Knopoff, Leon.** Density-velocity relations for rocks, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1-3, p. 1-8, illus., table, 1967.

Experimental data of Birch for rocks at 10 kilobars are found to fit an empirical relationship between scaled velocity and scaled density. The scaling factors are functions of the representative atomic number. An empirical relationship is found connecting the representative atomic number and the mean atomic weight.—Author's summary

02711 **Ko, Hon-Yim; Scott, Ronald F.** Deformation of sand in shear: Am. Soc. Civil Engineers Proc., v. 93, paper 5470, Jour. Soil Mechanics and Found. Div., no. SM5, pt. 1, p. 283-310, illus., 1967.

The behavior of Ottawa sand under different combinations of hydrostatic and deviatoric stresses has been studied in a new soil test box. The general shearing behavior is described with special reference to proportions of elastic and plastic components of deformation. These were examined by loading and unloading the sample along preselected stress paths. The sample was under a three-dimensional stress state and the required stresses were generated by means of a stress control device developed in connection with the test box. Deformations produced by shearing along a straight stress path in an octahedral plane varied with octahedral shear stress; from shear unloading along the same stress paths, the elastic components of deformation were comparable in magnitude to plastic components. With constant hydrostatic stress, the rate of expansion increased at failure.—GDC

02539 **Kobayashi, Kazuo; Fuller, M. D.** Vibration magnetometer, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 450-456, illus., 1967.

A vibration magnetometer based on a vibrating-sample technique is preferred generally to the vibrating-coil method because it is very insensitive to local magnetic noise and measurements can be made rapidly.—LLP

Kobayashi, Kazuo. *See* Fuller, M. D. 02869

Koch, George S., Jr. *See* Link, Richard F. 02702

Komatsu, H. *See* Tolansky, S. 02671

Kopf, Rudolph W. *See* Morris, Hal T. 02471

Koteff, Carl. *See* Hartshorn, Joseph H. 02705

Kovach, Robert L. *See* Breiner, Sheldon. 02945

03012 **Kovach, Robert L.** Relative attenuation of compressional wave energy in the mantle [abs.], *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 371, 1967.

Krogh, T. E. *See* Davis, G. L. 02736

02631 **Kullerud, G.** The Fe–Mo–S system: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 337–342, illus., 1967.

The Fe–Mo–S system has been studied experimentally in an effort to determine the limits of solid solution of pyrite in molybdenite and of molybdenite in pyrite. Results indicate that if Mo_5FeS_{11}, the composition of a recently reported mineral from Russia, is indeed a compound in the Fe–Mo–S system, it is stable only below 600°C and the reaction rates of its formation from MoS_2 and FeS are too slow to produce measurable DTA effects. Phase relations in the system between 600°C and 750°C are described.—MST

Kullerud, G. *See* Craig, J. R. 02633

Kullerud, G. *See* Craig, J. R. 02634

02635 **Kullerud, G.** The Fe–S–O–H system: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 352–354, illus., 1967.

Exploratory experiments in the system Fe–S–O–H were conducted in silica tubes in the 200°–300°C temperature range. Results of these experiments are described.—MST

Kullerud, G. *See* Naldrett, A. J. 02640

Kullerud, G. *See* Naldrett, A. J. 02641

Kullerud, G. *See* Craig, J. R. 02645

Kullerud, G. *See* Brett, Robin. 02696

Kullerud, G. *See* Bell, Peter M. 02728

02729 **Kullerud, G.; Donnay, G.** Sulfide–oxide relations: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 356–357, 1967.

Experiments have been performed on systems containing common sulfides and common oxides to establish stability limits of sulfur–oxide assemblages in ores. It was found that when spinel structure minerals such as magnetite, chromite, and hercynite are heated with sulfur in silica tubes with minimum vapor volume, certain reactions take place. Experiments with high-purity magnetite and sulfur in the 300° to 650°C range produced pyrite without destroying the magnetite structure, indicating that iron was being removed from the magnetite structure to produce an iron deficient magnetite. Similar experiments performed on chromite and hercynite at 600°C also showed that the spinel structure is retained with considerable iron deficiency.—MST

02496 **Kvenvolden, Keith A.; Weiser, Dan.** A mathematical model of a geochemical process—Normal paraffin formation from normal fatty acids: Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1281–1309, illus., 1967.

A process by which normal paraffins may be derived from normal fatty acids in sediments is represented by a mathematical model. Coupled differential equations describe changing distributions of fatty acids and paraffins as fatty acids undergo reactions involving decarboxylation and(or) hydrogenation (reduction). Model distributions of fatty acids and paraffins for various parameters are observed at different times during the paraffin forming process. The model duplicates many

but not all of the distributional relationships observed in sediments between fatty acids and paraffins especially in the range C_{17}–C_{36}.—Authors' abstract

02466 **LaMarche, Valmore C., Jr.** Spheroidal weathering of thermally metamorphosed limestone and dolomite, White Mountains, California, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C32-C37, illus., tables, 1967.

Silicate-free carbonate rocks in the White Mountains, Calif., weather spheroidally only in contact aureoles near intrusive bodies. Comparison of the textures of the bedrock and soil indicates that the spheroidal weathering is the result of granular disintegration of joint blocks. Selective grain-boundary corrosion during weathering probably causes this disintegration and is thought to be the result of intergranular stresses that developed on cooling, following high-temperature recrystallization. Exfoliation is regarded as an indirect consequence of increased porosity near the margins of a weathering block.—Author's abstract

Lambert, D. G. *See* Archambeau, C. B. 03008

02961 **Lambert, T. W.** Availability of ground water in the Paducah West and East quadrangles, Illinois and Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol Inv. Atlas HA-177, 2 sheets, scale 1:24,000, text, 1967.

Ground water in the Paducah area, a land of many rivers, is a relatively untapped resource having a large potential. Mississippian bedrock, the largest aquifer, ranging in depth from 130 to >500 feet, is the best source for industrial demands. The Cretaceous McNairy Formation, thickness range 30-280 feet, has an unknown potential; Upper Cretaceous to Pliocene(?) sands and gravels are adequate aquifers for domestic needs; Quaternary alluvium has great potential for industrial use. Development of ground-water supplies in alluvial valley areas faces problems of annual spring flooding and high iron content. Water from Mississippian, Cretaceous, and alluvial aquifers is hard, that from Eocene sands, soft. Some dug wells yield water with nitrate content of more than 45 ppm. Urbanization may cause pollution of shallow aquifers.—MCM

02836 **Land, Lynton S.** Diagenesis of skeletal carbonates: Jour. Sed. Petrology, v. 37, no. 3, p. 914-930, illus., tables, 1967.

Processes of stabilization which skeletal reactants undergo have been investigated by hydrothermal techniques, and products studied in thin sections. Results indicate that different stabilities of the various skeletal reactants permit different mechanisms of diagenesis to operate, and a variety of products to form. Stabilization, in many cases, is an early process in the history of carbonate rocks, and therefore preferential reactions of metastable phases indicate an early age for the reactions.—*from* Author's abstract

02969 **Lander, James F.** ESSA's National Earthquake Information Center is one year old: Earthquake Inf. Bull., v. 1, no. 6, p. 10-12, illus., 1967.

The new services initiated by the NEIC are: (1) the Earthquake Early Reporting Service—to provide accurate information within a few hours on larger earthquakes, (2) the Earthquake Information Bulletin, and (3) a focus for direct inquiries from groups needing earthquake information.—LLP

03011 **Landisman, M.; Mueller, S.; Fuchs, K.** Further evidence for the sialic low velocity zone in continental areas [abs.], *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1-3, p. 367-368, 1967.

02490 **Larimer, John W.; Anders, Edward.** Chemical fractionation in meteorites—[Pt.] 2, Abundance patterns and their interpretation: Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1239-1270, illus., tables, 1967.

Abundances of 31 volatile elements in meteorites are reviewed. The results suggest that chondrites are mixtures of a low-temperature fraction (matrix) that retained

most of its volatiles, and a high-temperature fraction (chondrules, metal grains) that lost them. These fractionations must have occurred in the solar nebula as it cooled. Accretion temperatures for the different types of chondrites are inferred from the abundance patterns. The model accounts for the presence of organic compounds and primordial noble gases in meteorites; the extreme depletion of Pb, Bi, Tl, and In in ordinary chondrites; and the low alkali content of the Earth and carbonaceous chondrites.—DBV

02493 **Larimer, John W.** Chemical fractionation in meteorites—[Pt.] 1, Condensation of the elements: Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1215–1238, illus., tables, 1967.

The condensation history of a cooling gas of cosmic composition is outlined. Two condensation sequences are derived, one for fast cooling, with formation of pure elements and compounds, and another for slow cooling, with formation of solid solutions. These sequences bear a striking resemblance to the depletion patterns observed in ordinary chondrites. It is proposed that the fractionation patterns observed in chondrites arose in the solar nebula during condensation and accretion. Subsequent heating in a meteorite parent body does not appear to have effected any further fractionation, with the possible exception of the most volatile trace elements, the noble gases, and Hg.—*from* Author's abstract

02438 **Larochelle, A.; Currie, K. L.** Paleomagnetic study of igneous rocks from the Manicouagan structure, Quebec: Jour. Geophys. Research, v. 72, no. 16, p. 4163–4169, illus., tables, 1967.

The Lower Triassic Manicouagan group is comprised of breccia, basalt diorite, and andesite, forming flat sheets partly filling a structural depression in Precambrian rocks. Cored, oriented samples show remarkably stable thermoremanent magnetization. Statistical analysis of the data shows that formation of the Manicouagan group has taken 10,000 years or less. Comparison with other Triassic pole positions from North America suggests that the area north of the St. Lawrence River has not rotated with respect to the rest of the continent since Triassic time.—Authors' abstract

02809 **Larochelle, A.** [Pt.] 1, Palaeomagnetic directions of a basic sill in Prince Edward Island; [Pt.] 2, Preliminary data on the palaeomagnetism of the North Mountain Basalt, Nova Scotia: Canada Geol. Survey Paper 67–39, 12 p., illus., tables, 1967.

Paleomagnetic directions obtained for 12 oriented samples from igneous rocks in Malpeque Bay, Prince Edward Island, suggest that the igneous rocks intruded the red beds in the area during Upper Permian time, prior to a period of mild folding. A paleomagnetic pole position obtained from 28 stably magnetized oriented samples from the North Mountain Basalt, differs substantially from that previously obtained from another suite of samples from the same rocks and is in much better agreement with poles derived from other North American Triassic formations. These data suggest again that the mean North American Triassic pole was at least 10° farther north than generally thought on the basis of early paleomagnetic measurements.—*from* Author's abstract

02923 **Larochelle, A.; Christie, K. W.** An automatic 3-magnet or biastatic magnetometer: Canada Geol. Survey Paper 67–28, 28 p., illus., tables, 1967.

The widely used 2-magnet, Blackett-type astatic magnetometer cannot be used efficiently for palaeomagnetic research in laboratories where the ambient magnetic field and its vertical gradient are subject to constant variations. It is shown that under such conditions, the 3-magnet or "biastatic" magnetometer is theoretically more stable and adequate. Considerations for the design of such an instrument are reviewed briefly and a description is given of an instrument of this type developed at the Geological Survey of Canada. An important feature of this instrument is that its operation can be carried out automatically. The results obtained in testing the performance of the instrument are analyzed.—Authors' abstract

02450 **Laughlin, W. S.** Human migration and permanent occupation in the Bering Sea area, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 409–450, illus., 1967.

The Bering land bridge provided two distinct types of routes for migration, coastal and interior. Conditions in the interior were severe, and the few inhabitants who found their way into North America probably became ancestors of the Indians. Coastal conditions were more congenial and the settlers became ancestors of the Aleuts and Eskimos, where biological affinities lie more with Asiatic Mongoloids than with American Indians. Coastal and interior adaptations on the platform provided the separation necessary for evolutionary divergence. However, Indians do display evidence of their Asiatic origin. Prehistory of the Umnak corner of the land bridge is reviewed, and some artifacts from the island pictured and described. Evidence points to continuous occupation of the eastern Aleutians, but no migration entered by way of them.—ESL

Leahy, C. J. *See* George, P. T. 02901

Lee, Della I. *See* Smith, Merritt B. 02999

02712 **Lee, I. K.** Stress-dilatancy performance of feldspar—Closure [to discussion of paper 4734, 1966: Am. Soc. Civil Engineers Proc., v. 93, Jour. Soil Mechanics and Found. Div., no. SM5, pt. 1, p. 315–316, 1967.

Khayatt's experimental studies have confirmed the writer's analysis of errors in measurement of deformations in the triaxial test. Direct measurement is certainly an improvement over the conventional method adopted in triaxial testing. However, the conventional frictionless ends do not operate perfectly, which can influence deformation characteristics. An element in the center of the sample, where end influence is minimal, manifests a stress dilatance plot almost identical with that based on overall measurements; this means that "errors" in incremental deformation due to end effects are virtually compensative. In tests for soil with a high friction angle, the departure appears to be a characteristic of the material or the particular test conditions.—GDC

02709 **Lee, Kenneth L.; Seed, H. Bolton.** Dynamic strength of anisotropically consolidated sand: Am. Soc. Civil Engineers Proc., v. 93, paper 5451, Jour. Soil Mechanics and Found. Div., no. SM5, pt. 1, p. 169–190, illus., 1967.

A large number of laboratory samples of Sacramento River sand, medium saturated sands, and a compacted silt, consolidated anisotropically to stresses equivalent to those acting in the ground behind earth slopes, were subjected to pulsating stresses simulating those expected to act on soil elements during an earthquake. Results indicated that strength under pulsating load increased with increasing density and increasing confining pressure. At low pressures pulsating loading strength was significantly less than the strength under static loading, while at high pressures it was slightly greater. Under anisotropic consolidation conditions, the higher the ratio of major to minor principal stress, the higher was the strength under pulsating loading conditions. The three types of soils tested under a wide range of conditions had similar behavior.—GDC

Lehner, Robert E. *See* Roberts, Ralph J. 02975

Leopold, Estella B. *See* Wolfe, Jack A. 02457

02990 **Lindsay, Delbert W.; Vickery, Robert K., Jr.** Comparative evolution in *Mimulus guttatus* of the Bonneville Basin: Evolution, v. 21, no. 3, p. 439–456, illus., tables, 1967.

To investigate comparative evolutionary rates in *Mimulus gattatus*, populations were selected from formerly flooded valleys, immediately below the level of ancient Lake Bonneville, geologically undisturbed areas above the old lake shore and below lowest glacial moraines, and as high into the formerly glaciated areas as *M. guttatus* occurs. The populations could have been in these habitats for average maxima of 8,500, 14,000, <50,000, and 12,000 years respectively. Instead of the expected differences

in evolutionary rates, the results indicate that the observed divergences and crossing barriers could have evolved in less than 4,000 years. The resulting picture is one of frequent emergence, change, and disappearance of distinctive populations, with the rare formation of one sufficiently distinct to be on its own evolutionary path.—LLP

02653 **Lindsley, D. H.** P–T projection for part of the system kalsilite–silica: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 244–247, illus., 1967.

The melting relations of potassium feldspar at total (dry) pressures up to 40 kb are discussed. The field of leucite plus liquid persists up to 19±1 kb; above that pressure high sanidine melts congruently. Where $P_{water} < P_{total}$, the primary phase field of leucite should persist to pressures greater than 2.6 kb in the simplified granite system. Melting relations of leucite are discussed also.—MST

02656 **Lindsley, D. H.** Melting relations of plagioclase at high pressures: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 204, 1967.

Study of the plagioclase system at dry pressures confirms that the effect of increasing pressure in solids is opposite to that of increasing water activity. Melting temperatures are increased by dry pressure in the region of congruent melting which with increasing pressure is confined to successively more sodic compositions. Thus at 20 kb, only plagioclase more sodic than An_{35} will melt congruently; experiments show that congruent melting occurs only between An_0 and An_{20} at 26 kb. At more than about 32 kb no plagioclase can crystallize as a primary phase from a melt of plagioclase composition. The present results show that high-pressure melting relations are no more successful than low-pressure relations in showing a minimum in the plagioclase melting loop that could help explain the genesis of Adirondack-type anorthosites.—MST

02659 **Lindsley, D. H.** Pressure–temperature relations in the system FeO–SiO_2: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 226–230, illus., 1967.

Past investigations and more recent investigations by the author indicate that ferrosilite ($FeSiO_3$) is stable only at high pressures and that at 1 atm it can form only metastably, if at all. In this study an attempt is made to elucidate the metastable formation of ferrosilite in terms of the P–T diagram for the system FeO–SiO_2. The attempt was unsuccessful, but the diagram is of general interest and is presented here. Data have been gathered during the past year on the melting of wüstite ($Fe_{1-x}O$) and of fayalite (Fe_2SiO_4) and combined with previous information obtained for $FeSiO_3$ compositions to construct much of the "binary" P–T diagram for the system FeO–SiO_2 up to 49kb.—MST

02719 **Lindsley, D. H.** The join hedenbergite–ferrosilite at high pressures and temperatures: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 230–234, illus., 1967.

An investigation of the hedenbergite–ferrosilite join at high pressures has been undertaken with the use of solid-media piston-and-cylinder apparatus. The results show that there is a continuous change toward $FeSiO_3$ of the most Fe-rich stable metasilicate with increasing pressure. This continuous shift in composition, combined with the fact that the entire range of compositions can be synthesized at 20 kb, strongly indicate that there is complete solid solution along the hedenbergite–ferrosilite join at subsolidus temperatures. Experiments at 900°C and 20 kb attempting to homogenize two pyroxenes or to break down a single pyroxene thus far have resulted in no reaction. Equilibrium relations of hedenbergite-rich pyroxenes, which become greatly simplified with increasing pressure, are summarized.—MST

Ling, Hsin-Yi. *See* Gross, M. Grant. 02867

02702 **Link, Richard F.; Koch, George S., Jr.** Linear discriminant analysis of multivariate assay and other mineral data: U.S. Bur. Mines Rept. Inv. 6898, 25 p., illus., tables, 1967.

Linear discriminant analysis employing the Mahalanobis d^2 method provides a means of discerning interrelationships between multivariate data. The efficacy of the procedure is demonstrated by application to assay data from the Frisco mine, San Francisco del Oro, Chihuahua, Mexico.—KFF

Lo, K. Y. *See* Stermac, A. G. 02762

03010 **Lomnitz, C.** On estimating earthquake risk [abs.], *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 375, 1967.

Lonsdale, John T. *See* Maxwell, Ross A. 02908

02912 **Lonsdale, John T.; Maxwell, Ross A.** Geology of intrusive igneous rocks, *in* Geology of Big Bend National Park, Brewster County, Texas: Texas Univ. Pub. 6711, p. 170–270, illus., tables, 1967.

Intrusive igneous masses occurring at many places in Big Bend National Park include dikes, sills, laccoliths, plugs, and irregular bodies. They are more abundant in a broad NW–SE belt centered around the Chisos Mts.; some were probably feeders for extrusive rocks which are thickest in this area. The intrusive rocks invade all Gulfian formations as well as Tertiary rock units; the dike swarm radiating from Dominguez Mtn. is most spectacular. Tortuga Mtn. appears to be the only siliceous mass to have cooled at great depths. Late Cretaceous intrusions are analcite-bearing mafic basalt, the Eocene intermediate—trachyandesite, and Oligocene or younger acidic—riebeckite rhyolite. Descriptions of the rocks in the various types of intrusions, located on geologic map in pocket and their chemical analyses and modes are tabulated.—GDC

02479 **Lovering, T. G.; Niles, M. S.; Graves, M. L.** Spectrographic data on the composition of basaltic rocks, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C113–C115, tables, 1967.

Grouped spectrographic analyses of 408 samples of basaltic rocks, from 16 States and 6 foreign countries, provide data on 34 elements. These data are summarized to furnish geologists with a background for comparison of spectrographic analyses on basalt.—Authors' abstract

02749 **Low, M. J. D.** Measurement of the infrared spectral reflection of some common minerals and rocks using multiple-scan interferometry: Appl. Optics, v. 6, no. 9, p. 1503–1506, illus., 1967.

Infrared reflection spectra (2500–250 cm^{-1}) of some minerals and rocks were recorded with a multiple-scan interference spectrometer. Samples were small, irregular, and unpolished. Spectra were obtained with some samples approximately 1 mm in diameter. Emission of samples was obviated by using the interferometer as chopper.—Author's abstract

02685 **Lowrie, Allen, Jr.; Heezen, Bruce C.** Knoll and sediment drift near Hudson Canyon: Science, v. 157, no. 3796, p. 1552–1553, illus., 1967.

A parallel-bedded accumulation of sediments forms a low ridge on the upcurrent side of a partially moated knoll. These sediments were deposited beneath a southwestward-flowing current where it is locally decelerated by the obstructing knoll.—Authors' abstract

02569 **Lucchitta, Baerbel Koesters.** Structure of the Hawley Creek area, Idaho–Montana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3993B–3994B, 1967.

Lull, Howard W. *See* Sopper, William E. 02784

MacDowell, J. F. *See* Wosincki, J. F. 02795

MacKenzie, Faustino. *See* Heatwole, Harold. 02989

02878 **MacLachlan, David B.** Structure and stratigraphy of the limestones and dolomites of Dauphin County, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G 44 (General Geology Rept.), 168 p., illus., tables, geol. map, 1967.

Middle Cambrian to Middle Ordovician carbonate rocks and Ordovician shales of the Great Valley in southern Dauphin County outcrop in two distinct belts having related stratigraphic sequences deposited in different environments, but now in proximity by tectonic superposition. The northern belt in Cumberland Valley shows northwesterly tectonic transport by overturned folds and steep thrusts, but is essentially upright; the southern belt in the Lebanon Valley is regionally inverted and displaced several miles by thrust faults. Revision of some stratigraphic details and a supplementary reference section for the type Myerstown and Hershey Formations are suggested. Chemical data support correlation and assist in evaluating potential reserves of the Annville Limestone and Ontelaunee dolomite; other rock is suitable for aggregates.—GDC

Maclay, R. W. *See* Winter, T. C. 02883

02920 **Maclay, R. W.; Winter, T. C.; Pike, G. M.** Water resources of the Two Rivers watershed, northwestern Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-237, 4 sheets, scale 1:250,000, text, 1967.

Sheet 1 contains information on the physical setting of the Two Rivers watershed, water budget, use, and summary of resources. On sheet 2, maps show water-level and bedrock contours, and tables summarize lithologic and water-bearing characteristics, and quality of water in general areas, glacial drift, and bedrock aquifers; appraisal of aquifers; and ground-water development near communities in the map area. Sheet 3 contains information on surface water, and sheet 4 relates to ground-water movement and water quality. Yields from 20–1,000 gpm of good quality water can be developed from glacial drift aquifers in the till plain. Communities in the lake plain are dependent upon surface water.—MCM

MacNeil, F. Stearns. *See* Durham, J. Wyatt. 02428

02745 **Malmberg, Glenn T.** Hydrology of the valley-fill and carbonate-rock reservoirs, Pahrump Valley, Nevada-California: U.S. Geol. Survey Water-Supply Paper 1832, 47 p., illus., tables, geol. map, 1967.

A report on the Pahrump Valley in 1948 (Maxey and Johnson) estimated average recharge at 23,000 acre-feet per year with all recharge available for development. Because of difficulty in salvaging subsurface outflow from the deep carbonate-rock reservoir, the present report concludes that the perennial yield may be only 12,000 acre-feet. In the mid-1940's many irrigation wells were drilled and large-capacity pumps were installed. During 1959–62 the net pumping draft averaged about 25,000 acre-feet per year. If the overdraft is maintained, depletion of stored water will continue and pumping costs will increase. Water levels in some areas declined more than 10 feet and can be expected to continue to decline at the projected rate of more than 3 feet per year. Chemical quality of water has been satisfactory but recycling for irrigation could cause deterioration with time.—*from* Author's abstract

02481 **Mamay, Sergius H.** Lower Permian plants from the Arroyo Formation in Baylor County, north-central Texas, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C120–C126, illus., 1967.

The first fossil plants to be found in the Arroyo Formation of the Clear Fork Group (Leonard Series, Lower Permian) are described. The plants were found in a small shale deposit near Lake Kemp in Baylor County, Tex. The assemblage is limited and poorly preserved, but nonetheless it contains two taxonomic novelties: *Brachyphyllum(?) densum*, n.sp. and *Wattia texana*, n.gen. and sp. *Brachyphyllum(?)* is obviously coniferous, but *Wattia* is problematical, both morphologically and taxonomically. The flora is mixed, with indications of affinities with the Permian floras of Europe, Cathaysia, and Angaraland. The relatively high proportion of

new taxa in this small collection suggests that the Arroyo Formation may ultimately produce a diversified flora of much morphologic and phytogeographic interest. Author's abstract

Manchee, E. B. *See* Weichert, D. H. 02514

02591 **Manger, G. Edward; Wertman, W. T.** Immobility of connate water in permeable sandstone, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C192-C194, table, 1967.

Some natural-state cores of moderately permeable Eocene sandstone, obtained by drilling with oil-base mud in Karnes County, Tex., appear to be saturated and other cores appear to be partially unsaturated. The variation of interstitial water chlorinity is related to the depositional environment of the different sandstone strata. These results suggest that a small fraction of connate water has remained immobile in the sandstone since the Eocene. Such immobility agrees with that found experimentally by Wyckoff and Botset and discussed theoretically by Irmay for a small fraction of fluid in a saturated permeable porous medium. Absence of significant diffusion over geologic ages seems to be necessary to explain the present results; reasons for this are not yet evident.—Authors' abstract

02986 **Manley, Fred H., Jr.** Use of clay mineralogy in determining source of deep basin sands [abs.]: Shale Shaker, v. 18, no. 1, p. 17, 1967.

02447 **Mansinha, L.; Smylie, D. E.** Effect of earthquakes on the Chandler wobble and the secular polar shift: Jour. Geophys. Research, v. 72, no. 18, p. 4731-4743, illus., table, 1967.

Changes in the products of inertia of the Earth are computed, using dislocation theory, for several large faults analyzed in the literature; from these changes, the contribution to the excitation of the Chandler wobble and resulting polar shift are calculated. The relationship between fault length and magnitude is used to provide additional information on the dependence of the contribution to wobble and polar shift on magnitude. The result of the study is to reinstate earthquakes as a possible source of Chandler wobble excitation and to show that if they are responsible for the wobble, they can also account for the astronomically observed secular polar shift.—DBV

Mapel, William J. *See* Sandberg, Charles A. 02482

03025 **Marden, D. W.** Deposition of Chester sandstones of Mississippian age in southwestern Kansas [abs.]: Shale Shaker, v. 18, no. 1, p. 15, 1967.

02960 **Martin, James A.; Wharton, Heyward M.** Some potential nonmetallic mineral resources in Missouri, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 162-176, illus., tables, 1967.

Nonmetallic mineral resources available in Missouri that have been little publicized include naturally occurring materials, and industrial wastes and byproducts. Among the more important are: mine and mill tailings; byproduct sulphuric acid and phosphates; shales and clays having bloating, absorptive, and binding qualities; and fly ash. Of less importance are impure fire clays, kaolinite clay deposits, and quartzite. Distribution and description of these mineral resources, including chemical and physical data where available, are given.—Authors' abstract

02739 **Mason, Harold.** Engineering properties of the first 100 feet of the Earth: Research/Devel., v. 18, no. 9, p. 32-37, illus., 1967.

Soil is unlike other engineering materials in that it has a wider range of structural properties and behaviors and because it must be taken as it occurs at a site. Due to the influence of geologic factors on the sequence, shape, and continuity of the soil strata, soils vary drastically. Two major types of soil are: (1) granular—with a relatively compact structure and composed of individual grains, and (2) flocculent—fine-grained soils that lack compact structure. Investigations of soil conditions

include surface surveys, *in-situ* testing, and laboratory tests. A problem of the *in-situ* testing is that a load test cannot predict the behavior of a large structure due to varying properties of the subsoils. Laboratory problems involve obtaining truly "undisturbed" samples for study.—LLP

02581 **Matthews, D. H.; Bath, Jennifer.** Formation of magnetic anomaly pattern of Mid-Atlantic Ridge, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 349–357, illus., 1967.

A magnetic survey of the crest of the Mid-Atlantic Ridge at 45° N. (Loncarevic, Mason, and Matthews, 1966) showed a pattern suggesting that the mechanism of dike injection is less regular than that utilized in the original theory of Vine and Matthews (1963). It seems plausible that dike injections do not always occur precisely along the median line but are scattered about it. An analog model experiment involving marbles and a computer analysis indicates that the great majority of dike injections must occur within the width of the median valley; the standard deviation of dike distribution (assumed normal) must be less than 5 km (half the width of the median valley).—DBV

02613 **Matthews, Jerry Lee.** Sedimentation of the coastal dunes at Oceano, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3566B–3567B, 1967.

Matthews, Robert A. *See* Weber, F. Harold, Jr. 02968

02431 **Maughan, Edwin K.; Roberts, Albert E.** Big Snowy and Amsden Groups and the Mississippian–Pennsylvanian boundary in Montana: U.S. Geol. Survey Prof. Paper 554-B, p. B1–B27, illus., tables, geol. map, 1967.

The Big Snowy Group is redefined to include the Kibbey, Otter, and Heath Formations, as the group was originally established. However, the Heath Formation, and consequently the top of the Big Snowy Group is restricted to strata beneath a Late Mississippian to Early Pennsylvanian regional unconformity. This restriction limits the Big Snowy to three closely related formations that comprise one sedimentary cycle uncomplicated by intraformational structural movements. The Amsden Group unconformably overlies the Big Snowy or Madison Groups and consists of three formations in central Montana that are stratigraphically and lithologically nearly equivalent to the type Amsden Formation in northern Wyoming. The formations, in ascending order, are the Tyler Formation, the Alaska Bench Limestone, and Devils Pocket Formation.—EKM

Maxwell, Charles H. *See* Sheridan, Douglas M. 02768

02908 **Maxwell, Ross A.; Lonsdale, John T.; Hazzard, Roy T.; Wilson, John A.** Geology of Big Bend National Park, Brewster County, Texas: Texas Univ. Pub. 6711, 320 p., illus., tables, geol. maps, 1967.

In Big Bend National Park, Texas, thick Tertiary volcanics and intrusives crop out in the central part, isolated Paleozoics in the northern part, and Cretaceous in widely distributed areas. A number of new unit names are introduced here, and in the Persimmon Gap–Dry Canyon area some units are given Marathon Basin names. Various locally abundant fossils, K–Ar ages, mineral and chemical data, and paleomagnetic data have been useful in correlation. Strata are complexly deformed by major folds and faults of the Laramide orogeny and by normal Tertiary faults. Subsequent weathering and erosion have produced spectacular mountain and canyon landforms. Sections on stratigraphy, Mammalia, intrusive igneous rocks, and structural geology are cited separately.—GDC

02909 **Maxwell, Ross A.** Memorial to John Tipton Lonsdale, 1895–1960, *in* Geology of Big Bend National Park, Brewster County, Texas: Texas Univ. Pub. 6711, p. xiv–xvi, portrait, 1967.

02910 **Maxwell, Ross A.; Hazzard, Roy T.** Stratigraphy, *in* Geology of Big Bend National Park, Brewster County, Texas: Texas Univ. Pub. 6711, p. 23–156, illus., tables, 1967.

Cretaceous and Tertiary formations cover most of the Big Bend area, but the represented span of time extends from early Paleozoic to Recent. In addition to established names from the Marathon and central Texas areas, new names are introduced for Cretaceous and Tertiary units in the Park. General and local features, briefly described, include structure and faunal assemblages; correlation tables and measured sections are added, with numerous photographic illustrations. References are made to the geologic maps in pocket. Marine invertebrates occur in the Comanchian and early Gulfian formations; reptile remains, shark teeth and fossil wood in the late Gulfian Mammalian remains are present but not abundant in some Tertiary formations. The total exposed thickness of the sedimentary and volcanic rocks is about 13,800 feet; post-Oligocene deposits are normally thin.—GDC

Maxwell, Ross A. *See* Lonsdale, John T. 02912

02913 **Maxwell, Ross A.** Structural geology, *in* Geology of Big Bend National Park, Brewster County, Texas: Texas Univ. Pub. 6711, p. 271–298, illus., 1967.

The Sierra del Carmen in Mexico and the southern Santiago Mts. in Texas form part of a structural and topographic highland along the eastern boundary of Big Bend National Park; Mesa de Anguila is an elevated fault block on the western boundary. Between them is a 40-mile wide unit called the Sunken Block, in which sedimentary rocks are much deformed, especially near igneous masses. The major structures include anticlines, faults and folds of various types, the largest of which have a northwest trend. The Chisos Mts., near the center of the Sunken Block, are capped by Tertiary lavas, the pluton flanked by deformed Gulfian and Eocene strata, some with vertical dip. Numerous areas are described, their features illustrated photographically. The Laramide orogeny and Tertiary deformation involved Paleozoic to Oligocene formations.—GDC

02790 **May, Robert F.; Striffler, W. David.** Watershed aspects of stabilization and restoration of strip-mined areas, *in* Forest hydrology—Natl. Sci. Found. Advanced Sci. Seminar, University Park, Pa., 1965, Proc.: London and New York, Pergamon Press, p. 663–671, illus., 1967.

Mountain watersheds strip mined for coal undergo severe mechanical and hydrological disturbances, such as higher stormflows and continuous flow of streams that were intermittent. Erosion and sedimentation from disturbed watersheds are attributable to slides from sidecast overburden, haul roads, and the mined area itself. Water quality can be affected by infiltration of water percolated through spoil material. Disturbance can be minimized by proper spoil placement to insure spoil-bank stability, and by adequate drainage control. Regrading after mining, often necessary, depends on the ultimate use of the area; revegetation is required for erosion control and bank stabilization.—GDC

Mayo, Lawrence R. *See* Péwé, Troy L. 02811

Mays, Robert E. *See* Skinner, Brian J. 02694

02488 **McCrone, Alistair W.** The Hudson River estuary—Sedimentary and geochemical properties between Kingston and Haverstraw, New York: Jour. Sed. Petrology, v. 37, no. 2, p. 475–486, illus., tables, 1967.

Most Hudson River estuarine channel sediments are clayey silts that contain about five percent easily oxidizable organic matter. Quartz is the most abundant coarse mineral and chlorite and illite are the dominant clay minerals. $H+$ is the chief exchangeable cation and most of the alkali and alkali earth cations are organic bound. Manganese may exceed sodium as an exchangeable cation. The muds appear to be capable of absorbing tremendous quantities of chemical pollutants.—HAT

02455 **McCulloch, D. S.** Quaternary geology of the Alaskan shore of Chukchi Sea, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 91–120, illus., table, 1967.

The first Quaternary event in this area was the late Pliocene–early Pleistocene marine transgression that left fossiliferous sediments on a wave-cut platform near Kivalina. A middle Pleistocene transgression, with two periods of high level, covered the northern coastal plain; its regression may have drained Chukchi Sea. The next rise, pre(?)-Illinoian, deposited sediments on the coastal plain and in Kotzebue Sound. Illinoian glaciers overrode the sediments, forming a large push moraine, Baldwin Peninsula. The Sangamon transgression left deposits along the entire coast, later mantled by loess from Wisconsin valley glaciers. Sediments of mid-Wisconsin transgression cover part of the coastal plain and contain ice-rafted boulders. A higher rise occurred during late Wisconsin. There was a warm period from about 10,000 to 8,300 B.P., but the thermal maximum was between 6,000 and 3,000 yr ago.—ESL

02707 **McCulloch, David S.; Bonilla, Manuel G.** Railroad damage in the Alaska earthquake: Am. Soc. Civil Engineers Proc., v. 93, paper 5423, Jour. Soil Mechanics and Found. Div., no. SM5, pt. 1, p. 89–100, illus., 1967.

Permanent horizontal movements of wet unconsolidated water-laid sediments were a major cause of damage to the Alaskan Railroad in the earthquake of 1964. The bearing strength of the unconsolidated sediments was so reduced by the shaking that embankments settled downward. Transient horizontal compression also occurred, some with considerable force. Linear surface irregularities localized surface cracks, and embankment settling produced cracks in adjacent sediments. At streams, where cracks developed in zones of distension, distances between stream banks were shortened; at crossings, bridge structures were arched or horizontally deflected.—GDC

03016 **McDaniel, Gary A.** An application of directional features and scalar properties of sediments to hydrocarbon exploration [abs.]: Shale Shaker, v. 18, no. 1, p. 12, 1967.

02750 **McGrain, Preston; Dever, Garland R., Jr.** Limestone resources in the Appalachian region of Kentucky: Kentucky Geol. Survey, ser. 10, Bull. 4, 12 p., illus., 1967.

Limestone is the principal source of concrete aggregate and road stone in the 49 counties comprising the Appalachian region of Kentucky. There are 41 active limestone operations which are limited to Mississippian and Ordovician rocks. Potential sources are in the Upper Mississippian limestones along the Pottsville Escarpment and Pine Mountain, Lower Mississippian limestones in the Cumberland and Green Rivers drainage basins, and Middle Ordovician limestone along the Kentucky River. Smaller quantities may be found in scattered Upper Ordovician and Upper Mississippian limestones.—LLP

02857 **McKee, E. D.; Crosby, E. J.; Berryhill, H. L., Jr.** Flood deposits, Bijou Creek, Colorado, June 1965: Jour. Sed. Petrology, v. 37, no. 3, p. 829–851, illus., tables, 1967.

A major flood along Bijou Creek, Colorado, in June 1965, spread sand across the creek channel and one-quarter to one-half mile beyond its banks. The flood sand is generally two to three feet thick, but a maximum measurement of twelve feet was obtained in one locality. Estimates indicate that horizontal or nearly horizontal strata constitute 90 to 95 percent of the deposits. Tabular planar crossbedding occurs in foresets along margins of depositional sheets of sand; climbing ripple laminae and convolute bedding developed locally during waning deposition and apparently away from the main flood path. The dominant, medium grain size (0.5–0.25 mm) of the sand probably was determined by size of particles available in the source area to the south; transportation of steel beams and concrete slabs from bridges indicates water velocity well above that required to carry medium-grained to coarse sand.—*from* Authors' abstract

02553 **McKee, E. H.; Nelson, C. A.** Geologic map of the Soldier Pass quadrangle, California and Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-654, scale 1:62,500, sections, 1967.

02614 **McLeroy, Donald Frazier.** Geology and origin of the Precambrian banded iron deposits at Cleveland Gulch, Iron Mountain, and Canon Plaza, Rio Arriba County, New Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3567B, 1967.

02758 **McManus, Dean A.** Classifications of submarine physiography in the Gulf of Alaska: Northwest Sci., v. 41, no. 3, p. 118–125, illus., 1967.

In early studies of physiography in the Gulf the echo sounders used were adequate only to identify large positive and negative relief features. As a result emphasis was placed on seamounts, ridges, and the trench as determining physiographic classification, which, therefore, was based solely on features of volcanic or diastrophic origin. With development of precision echo-sounding recorders, came an emphasis on the low relief features, as abyssal hills and plains, resulting in emphasis on turbidity current deposition as a factor in developing the surface. The present classification places equal significance on surfaces developed by sedimentation, volcanism, and diastrophism. Five maps show physiographic provinces as previously identified and as delimited in this paper.—ESL

McManus, Dean A. *See* Gross, M. Grant. 02867

Mecarini, G. *See* Miller, H. J. 02977

02443 **Megrue, G. H.** Correction to paper by G. H. Megrue "Rare-gas chronology of calcium-rich achondrites" [1966]: Jour. Geophys. Research, v. 72, no. 18, p. 4771, 1967.

Measurements reported for the Shergotty meteorite (ibid., v. 71, no. 16, p. 4021–4027, 1966) are found to have been made on a mislabeled sample of Estherville.—DBV

02595 **Meisler, Harold; Becher, Albert E.** Hydrogeologic significance of calcium-magnesium ratios in ground water from carbonate rocks in the Lancaster quadrangle, southeastern Pennsylvania, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C232–C235, illus., table, 1967.

The ratios in equivalents of calcium to magnesium in ground water from the limestones and dolomites of the Lancaster quadrangle in southeastern Pennsylvania correlate well with the composition of the carbonate source rocks. The lowest calcium-magnesium ratios occur in water from dolomite; the ratios are very close to the stoichiometric proportion of calcium to magnesium in the mineral dolomite. The highest calcium-magnesium ratios are in water from limestone. In ground water from interbedded limestone and dolomite, the calcium-magnesium ratios are between those in water from limestone and those in water from dolomite. When applied with caution, calcium-magnesium ratios in ground water can be an aid to geologic mapping of a limestone and dolomite terrane.—Authors' abstract

Melson, William G. *See* Pierce, J. W. 02835

02669 **Menard, H. W.** Sea-floor spreading, topography, and the second layer: Science, v. 157, no. 3791, p. 923–924, table, 1967.

Local sea-floor topography and also the thickness of the second layer of the oceanic rise-ridge system appear related to the spreading rate in the region. Slow spreading, away from the ridge center at 1 to 2 cm per yr, is associated with a thick second layer, a central rift, and adjacent rift mountains. Fast spreading, 3 to 4.5 cm per yr, is associated with a thin second layer and subdued topography lacking any central rift. The volume of lava discharged in this layer per unit time and per unit length along the crest of the whole active system is relatively constant regardless of the spreading rate. Total second layer discharge of the system has been about 5 to 6 km^3 per yr during the last several million years.—Author's abstract

Mensik, J. D. *See* Huffman, Claude, Jr. 02434

02856 **Menze, R. J.** Producing western bentonite for market, *in* Mining Symposium, 28th Ann., and AIME, Minnesota Sec., 40th Ann. Mtg., Duluth, 1967: Minneapolis, Minn., Univ. Minnesota, School Mineral and Metall. Eng., p. 49-52, illus., 1967.

Bentonite is a type of clay in which montmorillonite, whose structure is described briefly, is the dominant clay mineral. Sodium is the primary adsorbed cation in western bentonites, which are thought to have originated by alteration of pyroclastic material deposited in an inland sea. In the Black Hills district, the main commercial bed, the Clay Spur, near the top of the Cretaceous Mowry Shale, is variable in thickness, 24-48 in., and sometimes is discontinuous. Most of the reserves in South Dakota have been exhausted; practically all clay is now mined in Wyoming. The bentonite is added to molding sands in foundries and to drilling muds; processing is described.—ESL

02575 **Mercado, Edward John.** Stress propagation in nonlinear viscoelastic materials [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3998B, 1967.

03007 **Michels, Joseph W.** Archeology and dating by hydration of obsidian: Science, v. 158, no. 3798, p. 211-214, table, 1967.

First hailed as a method of absolute dating akin to the radiocarbon method, the method based on the degree of hydration of obsidian is now considered most useful as a highly precise tool for relative dating of artifacts. For the cost of one commercially processed radiocarbon date, the archeologist can obtain 80 or more obsidian dates. A large-scale dating sample (anywhere from 60 to 500 dates) at a given site has many applications. Obsidian was heavily utilized in most of the world's critical areas of prehistoric research, and recently it has been discovered that materials other than obsidian (fused shale, for example) do hydrate and therefore are susceptible to dating by this technique.—DBV

02849 **Mickey, W. V.** Government and industry cooperate in nuclear detonation: Earthquake Inf. Bull., v. 1, no. 6, p. 2-3, 1967.

In October 1967, the Atomic Energy Commission detonated a nuclear explosion called the "Gasbuggy", in the Pictured Cliffs Formation, San Juan Basin, N. Mex., to test the possibility of increasing natural gas production in the area. The Chase series of explosions in the Atlantic and Pacific Oceans have been continued, and a series of high explosive detonations were carried out near Salt Lake City, Utah, by the Air Force Special Weapons Center.—LLP

02850 **Mickey, W. V.** Controlled large-scale explosions—A valuable seismological tool: Earthquake Inf. Bull., v. 1, no. 6, p. 11, 1967.

Underground nuclear explosions enable seismologists to determine traveltimes of seismic waves more accurately, and make it easier to pinpoint earthquakes. Several nuclear explosions are being planned to facilitate oil and gas recovery in areas where it is not now economically practical.—LLP

Mielenz, R. C. *See* Davis, R. E. 02889

02977 **Miller, H. J.; Tirey, G. B.; Mecarini, G.** Mechanics of marine exploration: Ocean Industry, v. 2, no. 6, p. 34-36, illus., 1967.

This paper summarizes the mechanics of exploring minerals as found in placer-type deposits under the ocean. Selection of a suitable and promising site depends on knowledge of the contents of near shore land rocks and drainage patterns. The principal tool for surveying is the seismic-reflection profiling system; the Sparker and other systems are described and procedure discussed briefly.—GDC

02548 **Milne, V. G.** Reeves township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 418, scale 1 in. to 1/4 mi., text, 1967.

With the exception of some late Precambrian diabase dikes, all rocks in Reeves-Penhorwood townships are of Archean age; foliation strikes east to east-northeast

with a marked divergence around the north end of the Reeves serpentinite intrusion. Outcrops are scarce and structural information is generally lacking. Drill hole and geophysical data indicate the presence of north–south faults in the Kukatush iron formation; it is possible that some of the diabase dikes occupy original fault planes. Several asbestos deposits associated with serpentinite bodies have been mined, small tonnages of barite were shipped as late as 1965, and traces of gold have been found. Indications are that the Kukatush iron orebody (thin-bedded magnetite–chert, carbonate–chert, and minnesotaite–chert) is thin and high in sulfides.—MCM

02549 **Milne, V. G.** Penhorwood township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 419, scale 1 in. to 1/4 mi., text, 1967.

The text for Reeves–Penhorwood townships is abstracted with the citation for Reeves township (See Milne, ibid., no. 418, 1967.).—MCM

02630 **Mining in Canada.** Canadian Jameison Mines: Mining in Canada, p. 13–14, March 1967.

Massive sulfide ore lenses are in intermediate to felsic tightly folded Keewatin lavas. Host rock is rhyolite and andesite and ore is located along the contact between coarse grained uniform lavas and fine grained lavas, particularly at the lower contact of siliceous rhyolite flows. Massive sulfide contains 2.48 percent copper, 4.22 percent zinc, 0.009 ounces per ton gold, and 0.85 ounces per ton silver.—ARK

02698 **Mitcham, Thomas W.** Emphasis: Econ. Geology, v. 62, no. 3, p. 421–425, 1967.

Techniques are important only as they are applied to the solution of problems. Better geologic mapping is critical to mineral exploration and our progress in understanding the earth. Empirical associations may be more helpful to the exploration geologist than attempts to use purely genetic theories. Quantification can aid reasoning, but is not useful as an end in itself.—WSW

02941 **Mitchell, William Spencer.** North Sulphur Mountain area, Ojai oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1966, v. 52, no. 2, pt. 2, p. 45–53, illus., table, 1967.

The convergence of the Sisar–Big Canyon and San Cayetano fault systems at the eastern end of the Upper Ojai Valley results in a complex stratigraphic relationship. Many of the formations exposed at the surface are also repeated at depth, and an understanding of the surface geology is a prerequisite to interpreting subsurface conditions. Intense late Tertiary and Quaternary faulting and further folding of a series of existing synclinal and anticlinal structures in the valley have created unusual and intricate structural conditions. The productive zone is found at an average depth of 3,150 feet and has an average thickness of 1,850 feet; the interval lies immediately below the base of the Big Canyon fault.—MCM

Mitterer, R. M. *See* Hare, P. E. 02732

02570 **Mitterer, Richard Max.** Amino acid and protein geochemistry in mollusk shells [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3994B, 1967.

02571 **Mogharabi, Ataolah.** Carbonate petrology of the Foraker Formation (Lower Permian), north central Oklahoma [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3994B, 1967.

02615 **Moisseeff, Alexis Nicolas.** The geology and the geochemistry of the Wilbur Springs quicksilver district, Colusa and Lake Counties, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3568B, 1967.

Montgomery, Kathleen M. *See* Roberts, Ralph J. 02975

02980 **Moore, James G.; Evans, Bernard W.** The role of olivine in the crystallization of the prehistoric Makaopuhi tholeiitic lava lake, Hawaii: Contr. Mineralogy and Petrology, v. 15, no. 3, p. 202–223, illus., tables, 1967.

The nature of near-surface crystallization of tholeiitic basaltic magma has been examined by studies of the prehistoric Makaopuhi lava lake of Kilauea Volcano, Hawaii. Analytical data on bulk rocks and olivines are evaluated and interpreted in terms of the crystallization history of the entire mass. It is concluded that the compositions of olivines in basaltic rock reflect those of the intratelluric stage of crystallization when cooling is very rapid and temperatures fall well below solidus within a few weeks. The prehistoric Makaopuhi lava lake data suggest that transformation toward equilibrium olivine compositions, even in surface crystallization, is brought about by interdiffusion of Mg, Fe, Mn, and Ni at temperatures well into the subsolidus range, probably as far as 800°C.—VSN

Morgan, JR. *See* Gastil, R. Gordon. 02499

02471 **Morris, Hal T.; Kopf, Rudolph W.** Breccia pipes in the West Tintic and Sheeprock Mountains, Utah. *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C66-C71, illus., 1967.

Three large breccia pipes of volcanic origin cut folded and faulted Precambrian-Paleozoic sedimentary rocks and Tertiary volcanic rocks in the Cherry Creek area, Juab County, Utah. Their most characteristic feature is giant inclusions of quartzite, argillite, boulder phyllite, shale, and limestone that have been transported from strata several thousand feet below the surface. Inclusions range in size from microscopic dust to a block 1,200 feet long and 500 feet wide; they constitute about one-third of the material filling the pipes. The matrix in which the larger inclusions are embedded resembles arkosic tuff, consisting of shattered fragments of quartz, K-feldspar, plagioclase, sparse biotite, and pumiceous shards in addition to the particles of exotic rocks. Locally this matrix has been chloritized, pyritized, and silicified, but no ore deposits are known to be associated with the pipes.—*from* Authors' abstract

02508 **Mountjoy, E. W.** Upper Cretaceous and Tertiary stratigraphy, northern Yukon Territory and northwestern district of Mackenzie: Canada Geol. Survey Paper 66-16, 70 p., illus., 1967.

The Upper Cretaceous and Tertiary stratigraphy of five widely scattered areas in Yukon and Northwest Territories is described, based on a reconnaissance study in 1962. Early Upper Cretaceous rocks are restricted to the Eagle Plain and Porcupine River areas and comprise nonmarine sandstones herein named the Eagle Plain Formation. Late Cretaceous and early Tertiary nonmarine sandstones occur at northwest Ogilvie Mountains, southern Richardson Mountains, and west side of Mackenzie Delta. The middle Tertiary Reindeer Formation outcrops on the east side of Mackenzie Delta. The distribution of the rocks and their nonmarine nature suggests that much of the region was emergent during the late Cretaceous and Tertiary with the last marine incursion taking place in Upper Cretaceous Santonian or Coniacian time.—*from* Author's abstract

03026 **Mueller, George N.** Cherokee sand possibilities, central Kansas [abs.]: Shale Shaker, v. 18, no. 1, p. 15, 1967.

Mueller, S. *See* Landisman, M. 03011

02436 **Muessig, Siegfried.** Geology of the Republic quadrangle and a part of the Aeneas quadrangle, Ferry County, Washington: U.S. Geol. Survey Bull. 1216, 135 p., illus., tables, geol. map, 1967.

In this area of northeastern Washington the oldest rocks, of late Paleozoic and Permian ages, comprise a thick metamorphosed eugeosynclinal suite, intruded by late Cretaceous plutons. Tertiary rocks are predominantly volcanic, of Eocene(?) to Miocene(?) ages. Tuffs and flows predominate among the basal Tertiary rocks, and are succeeded by widespread hypabyssal intrusives and plutonic rocks. The Republic graben, trending N. 15° E., is the dominant structural feature of the area and was a long-lived Tertiary depositional basin; most of the Tertiary rocks are confined to this graben. Tertiary rocks were folded at least twice, and in the Oligocene were thrust eastward 4.5 miles. Epithermal gold-silver-quartz veins of current economic importance were formed in the Oligocene.—SM

02423 **Müller-Beck, Hansjürgen.** On migrations of hunters across the Bering Land Bridge in the upper Pleistocene, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 373–408, illus., 1967.

The climatic and geographic history of the land bridge and paleolithic developments in the Old and New Worlds during the late Pleistocene allow a partial reconstruction of diffusion and migration events. The ancestry of the Llano complex should be placed in a complex of Mousteroid industries widespread in Eurasia in the middle late Pleistocene, and must have crossed the land bridge about 28,000 yr ago, to become the Paleo Indian culture. The Aurignacoid industries were present in Siberia at least 15,000 yr ago, and it is assumed were in Alaska about the same time, but isolated from the earlier migration by coalescing glaciers. These developed into the Eskimos and Aleuts cultures. Physical anthropologic observations agree with these conclusions.—ESL

Mulligan, G. A. *See* Porsild, A. E. 02944

02921 **Multer, H. Gray.** Bedrock geology of Wayne County, Ohio: Ohio Div. Geol. Survey Rept. Inv. 61, 1 sheet, scale 1:62,500, section, text, 1967.

Mineral resources of Wayne County are: coal, mainly from Sharon, Brookville, and Lower Kittanning beds; clay and shale for refractory, and aggregate and brick purposes, respectively; limestone from the Mercer and Putnam Hill Limestones; oil and gas from Berea Sandstone, drillers' Newburg dolomite and "Clinton" sequence, and the Cambrian Trempealeau Dolomite; salt from Silurian deposits; sandstone from Sharon conglomerate; and sand and gravel from glacial deposits.—MCM

Munizaga, Fernando. *See* Davis, G. L. 02736

02772 **Nagy, Bartholemew; Colombo, Umberto.** (editors). Fundamental aspects of petroleum geochemistry: Amsterdam and New York, Elsevier Publishing Co., 388 p., illus., tables, 1967.

Investigations on the composition, physical characteristics, and modes of occurrence of crude oil and natural gas, together with similar systematic studies on coal, have led to the broader field of organic geochemistry. Current interest ranges from lipids in Precambrian rocks and the nature of kerogen to organic matter in carbonaceous meteorites. Chapters of this book, contributed by active and authoritative researchers with some controversial hypotheses, deal with the geology of petroleum, clay mineralogy, petroleum hydrocarbons, nonhydrocarbon compounds in petroleum, geochemistry of porphyrins, asphaltic components of petroleum, geochemical evaluation of petroleum migration and accumulation, and origin and evolution of petroleum. Four chapters by C. E. Weaver, G. W. Hodgson and others, P. A. Witherspoon and R. S. Winniford, and E. G. Baker, are cited individually.—GDC

02640 **Naldrett, A. J.; Kullerud, G.** Investigations of the nickel-copper ore and adjacent rocks of the Strathcona Mine, Sudbury District, Ontario: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 302–320, illus., table, 1967.

The distribution of sulfides in and around the Strathcona mine, Sudbury District, Ontario, and the composition of associated pyroxenes are examined. Observations indicate that the sulfide ore was not carried up with the main body of the Nickel Irruptive but was introduced as a sulfide liquid in suspension in the magmas of the younger intrusives. Study of distribution of iron and magnesium between augite and hypersthene suggests the possibility of using the distribution coefficient as a geological thermometer. The distribution coefficients in the younger noritic intrusions are in accord with the hypothesis that the sulfides in these rocks were introduced when the rocks were molten. A revised terminology for parts of the Nickel Irruptive is given.—MST

02641 **Naldrett, A. J.; Kullerud, G.** Limits of the $Fe_{1-x}S$–$Ni_{1-x}S$ solid solution between 600° and 250°C: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 320–326, illus., table, 1967.

The purpose of this study is to determine how pentlandite first forms during the emplacement and cooling of iron–nickel sulfide ore deposits. The results of experiments delineating the sulfur-rich and sulfur-poor limits of the $(Fe,Ni)_{1-x}S$ solid solution field containing up to 10 weight percent nickel between 600°C and 250°C are described. Provided they were formed above 500°C as equilibrium assemblages, pyrrhotite–pentlandite ores containing less than 10 percent nickel were deposited as homogeneous monosulfide solid solutions. All pentlandite in such ores is therefore the result of exsolution from the $(Fe,Ni)_{1-x}S$ solid solution.—MST

02642 **Naldrett, A. J.** Partial pressure of sulfur in the vapor coexisting with the $Fe_{1-x}S$-$Ni_{1-x}S$ solid solution at 600°C: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 326–328, illus., 1967.

The partial pressure of sulfur in the vapor coexisting with the $Fe_{1-x}S$–$Ni_{1-x}S$ solid solution at 600°C has been determined by a method similar to that described by Toulmin and Barton (1964). Compositions lying on two sections across the monosulfide solid solution sample at five and ten weight percent nickel were used.—MST

Nation, J. B. *See* Hales, A. L. 02668

02717 **Negas, Taki.** Phase equilibria studies in the systems PbO–Cr_2O_3–O_2 and PbO–SrO–O_2 [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 4050B, 1967.

Nelson, C. A. *See* McKee, E. H. 02553

02501 **Nelson, C. Hans.** Sediments of Crater Lake, Oregon: Geol. Soc. America Bull., v. 78, no. 7, p. 833–848, illus., tables, 1967.

Along shore and nearshore-slope sediments of Crater Lake include patchy deposits of medium sand that probably resulted from sublacustrine and subaerial mass movements. Mud-layer sediments of the basin floor and sediments of the intracaldera volcanic structures contain distinctive organic content, poor sorting, and silt-size median diameters suggesting that they were formed by continuous sedimentation of suspended material brought in by winds from outside and within the caldera, and by streams, sheet wash, and mass movements down the caldera wall. Good sorting, median diameters of fine-sand size, and the mineral composition of basin sand layers indicate that mass movements from the slopes occasionally generated turbidity currents that carried sand across the flat basins to the lake center.—HCW

02767 **Neuman, Robert B.** Some silicified Middle Ordovician brachiopods from Kentucky: U.S. Geol. Survey Prof. Paper 583-A, p. A1–A14, illus., 1967.

New species of *Heterorthina, Pionodema, and Pionomena* based on silicified specimens from the Lexington Limestone are described, and *Dalmanella sulcata* Cooper and *D. bassleri* Foerste are redescribed.—RBN

02572 **Nevin, Andrew Emmet.** Geology of the paragneiss on the east flank of the Kaniksu batholith, Boundary County, Idaho [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3995B, 1967.

02573 **Newman, Walter S.** Late Pleistocene environments of the western Long Island area [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3995B, 1967.

02445 **Nicholls, Harry R.; Rinehart, John S.** Geophysical study of geyser action in Yellowstone National Park: Jour. Geophys. Research, v. 72, no. 18, p. 4651–4663, illus., table, 1967.

Seismic and steam activity associated with several geysers in Yellowstone National Park, especially the Old Faithful geyser, were studied simultaneously. Three distinct phases were evident in the Old Faithful eruption cycle: following an eruption, continuous steam activity and no seismic activity; steam and seismic activity increasing or decreasing together; and directly preceding the next eruption, no steam or seismic activity. The three phases are believed to be indicative of the filling

of the underground reservoir with water, heating, and superheating, respectively, which triggers the eruption. A limited study of eight other geysers suggests that each has its individual seismic signature.—Authors' abstract

Nicholls, J. *See* Carmichael, I. S. E. 02444

Niles, M. S. *See* Lovering, T. G. 02479

02616 **Noble, James Peter Allison.** A paleoecologic and paleontologic study of an Upper Devonian reef in the Miette area, Jasper National Park, Alberta, Canada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3568B–3569B, 1967.

02765 **Nussbaum, Herbert.** Discussion [of "Static and seismic behaviour of an earth dam," by W. D. L. Finn, 1967], *in* Papers presented at the 19th Canadian Soil Mechanics Conference, Pt. 1: Canadian Geotech. Jour., v. 4, no. 1, p. 38–39, 1967.

Nussbaum believes that Finn's finite element analysis (ibid., p. 28–37) should be carried farther to predict the safety against total shear failure as well as the movement leading to it. Stress distribution in the dam might be demonstrated by deriving a cross section showing trajectories.—ESL

O'Connor, J. T. *See* Rogers, C. L. 02555

02879 **Ogilvie, W. P.** Canada, *in* Symposium on the organization of geology overseas: Geol. Soc. London Proc. 1965–66, no. 1633, p. 99–102, 1967.

The history of the Geological Survey of Canada and types of geological organizations in Canada are reviewed briefly. Each of the ten provinces of Canada has some form of geological survey closely associated with exploitation of mineral resources. All major Canadian universities have strong earth-science departments, with members of most faculties acting as provincial geologists in the summer; their graduates and fellows have made important contributions to geology around the world. The Geological Survey gives summer employment to interested students and has published results of their theses. Expanding commercial activity has employed large numbers of young geologists. Various geological societies have had ambitious programs in collection and dissemination of geological information.—GDC

02884 **O'Hara, M. J.; Yoder, H. S., Jr.** Formation and fractionation of basic magmas at high pressures: Scottish Jour. Geology, v. 3, pt. 1, p. 67–117, illus., tables, 1967.

Experiments were conducted at 30 kb on dry synthetic mixtures in the join diopside-pyrope, a number of compositions in adjacent parts of the plane $CaSiO_3$–$MgSiO_3$–Al_2O_3, and one in the plane diopside-pyrope-forsterite; on joins chrome diopside-enstatite, chrome diopside-pyrope, and chrome diopside-pyrope-olivine in minerals of a garnet-peridotite nodule in kimberlite, and join garnet-omphacite in minerals of an eclogite nodule in kimberlite; and on a whole-rock sample of eclogite nodules in kimberlite. Results give a new fractionation scheme at high pressure in which hypersthene-normative picrite or olivine tholeiite magma is the primary liquid, formed by partial melting of garnet-peridotite mantle; precipitation of garnets and clinopyroxenes leads to development of alkaline and silica-poor mafic magmas.—*from* Authors' abstract

Ojakangas, Richard W. *See* Beall, Arthur O., Jr. 02863

02442 **Oliver, Jack; Isacks, Bryan.** Deep earthquake zones, anomalous structures in the upper mantle, and the lithosphere: Jour. Geophys. Research, v. 72, no. 16, p. 4259–4275, illus., table, 1967.

Regional seismic data for the Tonga–Kermadec and other island arcs suggest that upper mantle zones associated with deep earthquakes are anomalous, in that they differ in certain properties from other parts of the mantle at comparable depths. Body waves propagating in the anomalous zones are less subject to attenuation than at similar depths elsewhere. If low attenuation correlates with strength, the lithosphere has been thrust or dragged down beneath the arc, and by implication

is mobile elsewhere. This possibility in turn suggests new approaches to a wide variety of problems.—DBV

02526 **Opdyke, N. D.** A large sampling drill, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 41–43, illus., 1967.

This type of drill which is used in Africa for mineral exploration is capable of drilling cores up to one and three-eighths inches in diameter to a depth of several hundred feet. Orientation techniques which enable cores to be oriented to a depth of 20 feet could be applied at far greater depths. Major limitations are lack of portability and the large supply of water required for the drill. Principal uses are in investigations requiring sampling at depth and where a sufficient number of specimens cannot be obtained from an outcrop at the surface.—LLP

Orr, R. William. *See* Rexroad, Carl B. 02798

02686 **Orr, W. N.** -Secondary calcification in the foraminiferal genus *Globorotalia*: Science, v. 157, no. 3796, p. 1554–1555, illus., 1967.

Populations of four species of the planktonic foraminiferal genus *Globorotalia* from sediments in the Gulf of Mexico show the effects of secondary thickening of the test. Quantitative tabulation of the distribution of thin- and thick-walled specimens illustrates an abrupt and separate depth at which the thickening takes place for each species.—Author's abstract

Osberg, Philip H. *See* Hussey, Arthur M. 02918

Ostenso, Ned A. *See* Vogt, Peter R. 02794

Packer, John G. *See* Johnson, Albert W. 02420

Palmer, J. E. *See* Kehn, T. M. 02585

02896 **Pampeyan, Earl H.; Schroeder, Marvin L.; Schell, Elmer M.; Cressman, Earle R.** Geologic map of the Driggs quadrangle, Bonneville and Teton Counties, Idaho, and Teton County, Wyoming: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-300, scale 1:31,680, sections, 1967.

The map sheet includes a table of lithologic descriptions and chemical analyses of the Meade Peak Phosphatic Shale Member of the Phosphoria Formation (analyses by K. P. Moore).—MCM

02738 **Papadakis, Jim.** Crystal Ice Caves, Idaho: Natl. Speleol. Soc. NSS News, v. 25, no. 8, p. 154–159, illus., 1967.

The Crystal Ice Caves are located in the central part of a large plain of Recent basaltic lava flows of the Snake River Lava Plain in southern Idaho. The Crystal Ice Caves Lava Field, northeast of the Wapi Lava Field and south of The Craters of the Moon Lava Field, is bisected by the Great Rift, a zone of huge cracks out of which the lava flowed. In the past, fluctuating flows from the Great Rift covered the Crystal Ice Caves Field many times, and a composite dike was formed. Although the origin of the caves is not clearly known, one theory is that after the molten phase of the eruption ended, the lava again receded to below the water table leaving large openings in the rift. When water encroached upon the cooling rift, steam was generated, pressure built up, and a gigantic explosion occurred.—LLP

02865 **Parham, Walter; Austin, George.** Clay mineralogy of the Glenwood Formation, southeastern Minnesota and adjacent areas: Jour. Sed. Petrology, v. 37, no. 3, p. 863–868, illus., table, 1967.

Kaolinite is most abundant in the southwestern part of the area studied, decreasing in amount to the northeast where illite is the only clay mineral. This is interpreted to indicate that the source of the sediment was to the southwest or west.—HAT

Park, Won C. *See* Amstutz, G. C. 02820

02502 **Parkin, D. W.; Delany, A. C.; Delany, Audrey Claire.** A search for airborne cosmic dust on Barbados: Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1311–1320, illus., tables, 1967.

Results of study of a year's continuous day by day collection of windborne dust on Barbados provide an upper limit of about 0.2 tons to Earth per day for any extraterrestrial material of size $>1\mu$ in the atmosphere. Magnetic metal flakes and spherules reported as extraterrestrial in a previous study (1967) and again found in the present work are contaminants. It is now proposed that the deep sea spherules originate from the surface ablation of meteorites, and do not arrive continuously from the zodiacal cloud. No evidence was found of any extraterrestrial 100--sized particles at the ground level collecting site.—DBV

02812 **Patton, B. J.** Magnetic shielding, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 568–588, illus., 1967.

An analysis of the magnetic state of magnetic shielding yields concepts and formulas which make the design of practical shields with predictable performance possible. The permeability, μ, is treated as a function of the induction which makes possible the reliable use of permeabilities up to ten times the initial permeability ordinarily used. Remanence is shown to be a dominant factor in shielding which can be controlled to provide zero field space with a stability of the order of 0.05 mOe. An 8-ft cubical shield is reported which reduces the 0.5 Oe Earth's field to 0.35 mOe. The remanence is easily adjusted to provide a field less than 0.01 mOe with a stability better than 0.05 mOe. The gradients are typically 0.02 mOe/ft.—Author's summary

Pauly, Hans. *See* Soen, Oen Ing. 02804

Pavlides, Louis. *See* Hussey, Arthur M. 02918

Peake, E. *See* Hodgson, G. W. 02774

Pereira, J. *See* Davidson, C. F. 02903

Pering, Katherin L. *See* Ponnamperuma, Cyril. 02495

02760 **Pessagno, Emile A., Jr.** Upper Cretaceous planktonic Foraminifera from the western Gulf Coastal Plain: Palaeontographica Americana, v. 5, no. 37, p. 245–445, illus., tables, 1967.

The area covered includes southwestern Arkansas, Texas, and Mexico. Hundreds of specimens of Foraminifera were thin sectioned and an analysis made of the morphology, phylogeny, and classification. A system of zonation using the Foraminifera is presented based on association of taxa, abundance and range zones, and phylogeny at the specific, generic and family levels. The majority of zonal units can be recognized in Eurasia and Africa, as well as in the Western Hemisphere. Two new families—Marginotruncanidae and Abathomphalidae—have been erected and are characterized. Three new genera and 12 new species have been erected also, and a neotype erected for *Rosalina canaliculata* Reuss.—ESL

Peterson, N. S. *See* Service, A. L. 02700

Peterson, Norman V. *See* Walker, George W. 02740

02764 **Peterson, R.** Discussion [of "Static and seismic behaviour of an earth dam," by W. D. L. Finn, 1967], *in* Papers presented at the 19th Canadian Soil Mechanics Conference, Pt. 1: Canadian Geotech. Jour., v. 4, no. 1, p. 42–43, 1967.

While the writer is not familiar with the details of the finite element method, he points out that Finn's conclusion (ibid., p. 28–37) appears to assume that ideal materials are involved, that presumably the method takes into account only the

two dimensional case, and that it does not appear to make adequate allowance for the time effects.—ESL

02917 **Peterson, Willis.** The Mogollon Rim—Pt. 2, Geology of the Rim: Arizona Highways, v. 43, no. 10, p. 3–4, illus., 1967.

Mogollon Rim, a fault scarp more than 200 mi long and averaging 1,500 feet high, trends northwest–southeast across central Arizona and into New Mexico, forming the southern margin of the Colorado Plateau. Rocks exposed are of Devonian–Permian age, covered by Tertiary to Recent lava flows in places. Formations described briefly are the Martin and Redwall Limestones, the Supai Formation, Coconino and Toroweap Sandstones, and Kaibab Limestone.—ESL

02459 **Péwé, T. L.; Hopkins, D. M.** Mammal remains of pre–Wisconsin age in Alaska, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 266–270, 1967.

Vertebrate remains found in Alaska before 1940 have no stratigraphic meaning, having been found on beaches or along streams before much was known of Quaternary stratigraphy. It is believed that most of the *Bos* and *Saiga* material came from Wisconsin silt. More recently vertebrate fossils have been found in beds of pre–Illinoian to Recent age. A checklist of mammals found in beds of pre–Wisconsin age in Alaska has extensive footnotes.—ESL

02811 **Péwé, Troy L.; Burbank, Lawrence; Mayo, Lawrence R.** Multiple glaciation of the Yukon–Tanana upland, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-507, scale 1:500,000, text, 1967.

Cirques, U–shaped valleys, moraines, and outwash plains of two geomorphic ages indicate at least two major alpine glaciations in the Yukon–Tanana upland; only 3–5 percent of the upland was glaciated. Correlation of these features to other Alaskan areas suggests the older and more extensive glaciation is Illinoian, the younger, Wisconsin in age. The semi–arid climate restricted extension of the glaciers into valley glaciers, and these never coalesced to form large piedmont ice sheets. Orientation of 1,088 cirques formed during the older glaciation is dominantly toward the north; during the younger glaciation at least 388 cirques were oriented more strongly northward, and almost all were located in those of the older glaciation.—*from* Authors' summary

02665 **Phillips, J. D.** Magnetic anomalies over the mid–Atlantic ridge near 27° N.: Science, v. 157, no. 3791, p. 920–923, illus., 1967.

Ten magnetic profiles across the mid–Atlantic ridge near 27° N. show trends parallel to and symmetry about the ridge axis; magnetic bodies that could account for the pattern support the Vine and Matthews hypothesis (1963). A polarity–reversal time scale inferred from sea–floor spreading models and radiometrically dated reversals indicates a spreading rate of 1.25 cm per yr during the last 6 m.y. and 1.65 cm per yr between 6 and 10 m.y. ago. Over the mid–Atlantic ridge near 22° N. the rate appears to have been 1.4 cm per yr for the last 5 m.y. and 1.7 cm per yr between 5 and 9 m.y. ago. The time and relative magnitude of these changes accords with the spreading rate implied for the Juan de Fuca ridge in the northeastern Pacific.—DBV

Phillips, R. *See* Davidson, C. F. 02903

02713 **Philpotts, A. R.** Origin of certain iron–titanm oxide and apatite rocks: Econ. Geology, v. 62, no. 3, p. 303–315, illus., tables, 1967.

Rocks containing two–thirds iron–titanium oxides and one–third apatite occur as small intrusive bodies associated with anorthosites and alkalic complexes. Experiments suggest that this is an eutectic mixture and that it forms a liquid that is immiscible with silicate melts of dioritic composition. Excess apatite forms a third immiscible liquid. Minimum temperatures of crystallization, estimated from the composition of magnetite–ilmenite pairs, are in the range 850°–1000°C. High

soda contents of alkalic magmas may be an important factor in forming these immiscible liquids.—WSW

03013 **Phinney, Robert A.; Alexander, Shelton S.** Diffraction of P-waves and the structure of the core-mantle boundary [abs.], *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 371, 1967.

02835 **Pierce, J. W.; Melson, William G.** Dolomite from the continental slope off southern California: Jour. Sed. Petrology, v. 37, no. 3, p. 963–966, illus., 1967.

A 500-pound manganese-covered dolomite boulder recovered from a depth of 1,719 meters about 20 miles southeast of Santa Rosa Island may represent formations of Tertiary age known on the mainland or it may represent a dolomitized foraminiferal ooze.—HAT

Pike, G. M. *See* Winter, T. C. 02883

Pike, G. M. *See* Maclay, R. W. 02920

02507 **Plesset, Milton; Dugas, Doris J.** Decay of a disturbance in the natural distribution of carbon 14: Jour. Geophys. Research, v. 72, no. 16, p. 4131–4137, illus., tables, 1967.

The decay of excess C-14 deposited in the atmosphere as a result of a nuclear explosion is calculated, using a cyclic model having four reservoirs for exchangeable carbon in which the atmosphere is considered to have an interface with both the mixed ocean layer and the deep sea. Calculations were made for exchange ratios of $\eta = 1$, 3, and 10 (η = ratio of atmosphere—mixed layer exchange rate to atmosphere—deep sea exchange rate). At $\eta = 10$ the decay pattern of the cyclic model approaches that of a chain model (no direct mixing between atmosphere and deep sea); for exchange ratios of 1 to 3 the long-term decay of C-14 in the atmosphere changes markedly, and thus it would be of considerable interest to obtain further data on the amount of mixing in the oceans.—DBV

Polivka, M. *See* Davis, R. E. 02889

02887 **Pollard, Lin Davis.** Sedimentation rate determinations on ocean bottom cores by gamma ray spectrometry: Florida State Univ. Sedimentol. Research Lab. Contr. 20, 90 p., illus., tables, 1967.

Gamma-ray spectrometry in which the Th-230 daughter, Bi-214, is non-destructively determined, is shown to be a reliable and simple method for sedimentation rate determination for the last 300,000 years. Gamma-ray spectrometry overcomes some of the objections of standard radiochemical separation procedures, including whether or not the leaching procedures pick up allogenic as well as authigenic Th-230. The sedimentation rates calculated from apparent uranium data are compared with those calculated from Th-230/Th-232 ratios, and with those determined by paleomagnetic methods for the 700,000 years reversal. The comparisons seem to indicate that the majority of the sediments used in this study were deposited at a slower rate for the last 300,000 years.—*from* Author's abstract

02480 **Polzer, W. L.; Roberson, C. E.** Calculation of ion activity products for a brine from the Bonneville Salt Flats, Utah, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C116–C119, illus., tables, 1967.

Ion activity products for the dissolution of gypsum, halite, mirabilite, and some carbonate minerals were calculated for a Bonneville Salt Flats brine with an ionic strength of 6.3. Environmental conditions of the brine at the time of sampling and of analysis indicated near equilibrium with respect to most of these minerals; the agreement between the ion activity products and equilibrium constants was good. These results indicate that calculation of activity coefficients and ionic complex concentrations can be made with a reasonable degree of accuracy for waters of high ionic strength.—Authors' abstract

02495 **Ponnamperuma, Cyril; Pering, Katherin L.** Aliphatic and alicyclic hydrocarbons isolated from Trinidad Lake asphalt: Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1350–1354, illus., 1967.

Aliphatic hydrocarbons isolated from the Trinidad Lake asphalt have been examined by gas chromatography and mass spectrometry. They appear to be unlike hydrocarbons recognized to be of biological origin and resemble synthetic mixtures. Possible explanations for their unusual character are considered and it is concluded that hydrocarbon mixtures exist in nature whose origin cannot be easily determined.—Authors' abstract

Poole, F. G. *See* Shawe, D. R. 02433

02944 **Porsild, A. E.; Harington, C. R.; Mulligan, G. A.** *Lupinus arcticus* Wats. grown from seeds of Pleistocene age: Science, v. 158, no. 3797, p. 113–114, illus., 1967.

Seeds of the arctic tundra lupine (*Lupinus arcticus*) at least 10,000 years old were found in lemming burrows deeply buried in permanently frozen silt of Pleistocene age in unglaciated central Yukon. They readily germinated in the laboratory and have since grown into normal, healthy plants.—Authors' abstract

02870 **Post, Edwin V.** Geology of the Cascade Springs quadrangle, Fall River County, South Dakota: U.S. Geol. Survey Bull. 1063–L, p. 443–504, illus., tables, geol. map, 1967.

The Cascade Springs quadrangle, at the south end of the Black Hills, S. Dak., is underlain by Permian through Late Cretaceous sedimentary rocks that have an aggregate thickness of 2,800 feet. Noncommercial uranium deposits have been found in the Inyan Kara Group of Early Cretaceous age, which consists of about 525–600 feet of terrestrial sandstones, siltstones, and mudstones. In the eastern part of the quadrangle the rocks are folded into the asymmetric southward-plunging Cascade anticline, which dips about 5° SE. and 40°–70° SW. The west half of the quadrangle includes part of the east limb of the Chilson anticline, a similar southward-plunging asymmetric anticline. Possible economic resources include uranium, gypsum, limestone, sand and gravel, ground water, and oil and gas.—*from* Author's abstract

Potratz, H. A. *See* Blanchard, R. L. 02448

02837 **Potter, Paul Edwin; Blakely, Robert F.** Generation of a synthetic vertical profile of a fluvial sandstone body: Soc. Petroleum Engineers Jour., v. 7, no. 3, p. 243–251, illus., table, 1967.

Stratigraphic sections of a fluvial sandstone body were synthesized with five bedding types: crossbedding, massive beds, parting lineation, ripple mark, and mudstone. The transition procedure from one bedding type to another used dependent, Markovian random processes which have a memory that extends one step backward in the depositional process. As observed in nature, median grain size and sand wave thickness decline upward in the sections as proportions of the different bedding types change. Grain size and permeability were also incorporated into the sections. By changing the transition procedures, bed thickness distributions, rate of upward decline or sand wave height and length, different types of sections can be synthesized, thus making it possible to model many different sedimentation problems.—*from* Authors' abstract

03029 **Potts, Ray H.** The depositional environments of the Spiro sands in the Arkoma Basin [abs.]: Shale Shaker, v. 18, no. 1, p. 16, 1967.

Poulis, J. A. *See* Weijts, A. G. L. M. 02538

02825 **Pouquet, Jean.** Quelques aspects géomorphologiques de la Vallée de la Mort, Californie (Some geomorphologic features of the Death Valley, California) [with German and English abs.]: Zeitschr. Geomorphologie, new ser., v. 11, no. 2, p. 183–204, illus., 1967.

Playas are the most typical form on the floor of Death Valley. Freezing and thawing of a thin layer of water covering the playa in winter is thought to cause rock tracks. Alluvial fans are an outstanding feature of the slopes; their asymmetry in the north-central section and the presence of dunes is attributed to torsional structure keeping water near the surface. Three sets of pediments have been formed by tectonic deepening of the median trench, the oldest and highest being connected with Pleistocene Lake Manly. Canyons are controlled by faults and contain small grabens with lake sediments. The ancient Amargosa River flowed south into Silurian or Soda Lake until it was captured near Tecopa, and now flows north for the last 80 km. Below Tecopa, its grade reflects recent tectonic movement of at least 600 mi.—ESL

02797 **Powell, Richard L.; Thornbury, William D.** Karst geomorphology of south central Indiana, Field Trip 1 *in* Geologic tales along Hoosier trails—Geol. Soc. America, North-Central Sec., 1st Ann. Mtg., 1967, Field Trip Guidebook: Bloomington, Ind., Indiana Univ. Dept. Geology and Indiana Geol. Survey, p. 9-38, illus., 1967.

This trip, south of Bloomington, covers two physiographic units that are developed on Mississippian carbonate rocks. The Mitchell Plain is a westward-sloping sinkhole-pitted low limestone plateau crossed by deeply entrenched streams including the Ohio, Blue, Lost, and White Rivers. Cavern development is associated with surface karst features. The Crawford Upland is a rugged dissected area developed on rocks of the Chester Series and separated from the Mitchell Plain to the east by the Chester escarpment. Structural benches along the valleys are common because of varied resistance of strata. Deep entrenchment of major streams occurred during Pleistocene time; associated caverns are of Pleistocene age. The meandering stream patterns are inherited from Pliocene time; caverns above the level of the Mitchell Plain are probably of Tertiary age.—VMJ

02841 **Presley, Bob J.; Brooks, Robert R.; Kappel, Henry M.** A simple squeezer for removal of interstitial water from ocean sediments: Jour. Marine Research, v. 25, no. 3, p. 355-357, illus., 1967.

A simple and inexpensive squeezer employed in the removal of interstitial water from ocean sediments has been designed. Squeezing is carried out with nitrogen at pressures of 500 to 1,000 lb/in^2 (35 to 70 kg/cm^2). The apparatus is lined with teflon, thus insuring complete freedom from metallic contamination.—Authors' abstract

02515 **Press, Frank.** Spectra of free oscillations from an aftershock sequence, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1-3, p. 219-222, illus., 1967.

The question arises as to whether the spectrum of oscillations generated by a main shock and its aftershock sequence differs from that of a single event. It is shown that a formal difference occurs if the probability of the occurrence of an aftershock and its magnitude are functions of time. When applied to an actual aftershock sequence, the discrepancy in frequency of the spectral peak is probably less than 0.01 minutes, although some skewing in the shape of the spectrum may occur.—Author's summary

02617 **Prinz, Martin.** Geologic evolution of the Beartooth Mountains, Montana and Wyoming—Pt. 4, Mafic dike swarms of the southern Beartooth Mountains [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3569B, 1967.

02822 **Prinz, William C.** Geology and ore deposits of the Philipsburg district, Granite County, Montana: U.S. Geol. Survey Bull. 1237, 66 p., illus., tables, geol. maps, 1967.

Ore deposits include (1) steeply dipping quartz veins containing silver and zinc sulfides, (2) silver-rich quartz veins along bedding, (3) manganese-rich replacement deposits, and (4) minor contact metasomatic magnetite deposits. X-ray data show that rich oxidized manganese deposits consist of cryptomelane, todorokite, nsutite,

pyrolusite, chalcophanite, hetaerolite, and manganite; rhodochrosite and manganoan dolomite are primary manganese minerals. The primary ores were deposited from hydrothermal solutions, and several stages of mineralization are recognized (from oldest to youngest): iron oxide, iron sulfide, zinc, lead, copper–silver, and manganese. Variations in composition and character of the orebodies are explained by progressive changes both in structural conditions and composition of the ore solutions.—WCP

02769 **Quinn, Alonzo W.** Bedrock geology of the Chepachet quadrangle, Providence County, Rhode Island: U.S. Geol. Survey Bull. 1241-G, p. G1–G26, illus., tables, geol. map, 1967.

The Chepachet quadrangle in northwestern Rhode Island is underlain by (a) several older(?) feldspathic gneisses of Precambrian(?) age; (b) Precambrian(?) Blackstone Series, including quartzite, quartz–mica schist, and amphibolite; and (c) extensive intrusive plutonic rocks ranging from diorite to granite, of Mississippian or older age. The older(?) gneisses and the Blackstone Series are much folded and were metamorphosed to the almandine–amphibolite facies. The intrusive plutonic rocks, which may have been intruded in one episode or in more than one episode, were partly syntectonic.—AWQ

02981 **Rahn, Perry H.** Sheetfloods, streamfloods, and the formation of pediments: Assoc. Am. Geographers Annals, v. 57, no. 3, p. 593–604, 1967.

Field observations of four floods in the desert plains of southwestern Arizona indicate that such floods have the following two characteristics: 1) Floods on pediments occur as streamfloods; sheetfloods are limited to the bahadas. 2) Streamfloods on pediments exhibit supercritical flow.—Author's abstract

Rambo, John T. *See* Stearns, Ronald T. 02972

02467 **Raup, Omer B.; Gude, Arthur J., 3d; Groves, H. Leon, Jr.** Rare-earth mineral occurrence in marine evaporites, Paradox basin, Utah, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C38–C41, illus., 1967.

A new calcium rare-earth borate mineral has been found in the marine evaporites in the Paradox Member of the Hermosa Formation of Pennsylvanian age in southeastern Utah. This is the first known occurrence of any rare-earth mineral from marine evaporites. The mineral occurs in nodules in a 6-inch zone in anhydrite which immediately overlies the potash deposit in the Cane Creek mine of the Texas Gulf Sulphur Co. near Moab, Utah. The occurrence of this mineral and its relation to the host rock indicates that it is a diagenetic mineral, most likely formed through incorporation of rare-earth elements concentrated in the evaporites and derived from sea water.—Authors' abstract

02746 **Raymond, Gerald P.; Crawford, C. B.; Eden, W. J.; Readshaw, E. E.** Discussions [of "The performance of an embankment on a deep deposit of varved clay," by A. G. Stermac et al *in* Papers presented at the 19th Canadian Soil Mechanics Conference, Pt. 1: Canadian Geotech. Jour., v. 4, no. 1, p. 61–66, illus., 1967.

The original paper (ibid., p. 45–61) describes a planned stage construction of embankments for approaches to an overpass near New Liskeard, Ontario, founded on deep varved clay. A case record which did not work out as planned is rare and of value. Points discussed are properties of this type of soil, possibilities of predicting settlement rates and pore pressures, possible existence of a remolded layer, and a request for sensitivity values.—ESL

Readshaw, E. E. *See* Raymond, Gerald P. 02746

02845 **Redeker, Immo H.** Concentration of South Carolina sillimanite: South Carolina Div. Geology Geol. Notes, v. 10, no. 4, p. 59–60, tables, 1967.

Sillimanite from a South Carolina ore was concentrated to see if refractory grade or whiteware grade sillimanite could be obtained. Flotation test results indicate that only 25 to 30 percent of the head feed could be recovered in products containing

41 to 42 percent Al_2O_3. Even in the −325+400 mesh fraction of the heavy liquid separations, only 35 percent by weight reports in the sinks which contain 58.7 percent Al_2O_3. It is doubtful that an economical amount of high grade sillimanite of 59 to 62 percent Al_2O_3 can be produced.—LLP

02487 **Reed, John C., Jr.** Observations on the Teton Glacier, Grand Teton National Park, Wyoming, 1965 and 1966, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C154-C159, illus., tables, 1967.

Resurvey in 1966 of markers placed across the Teton Glacier near the snowline in 1963, 1964, and 1965 indicates that the average rate of ice movement near the center is probably about 28 feet per year. Previously computed and reported movement rates of 30 to nearly 35 feet per year between 1963 and 1964 are too high because of surveying errors. Transverse profiles indicate that the central part of the glacier was 2-8 feet thicker in 1966 than in 1963. Direct measurement in a glacier mill near the surveyed profile indicates that the ice is about 64 feet thick. Locally, the terminus has advanced as much as 30 feet, but most of it remains in virtually the same position as in 1963.—Author's abstract

02978 **Reidy, F. A.** Vehicle makes ocean-bottom surveys: Ocean Industry, v. 2, no. 6, p. 40-44, illus., 1967.

An underwater vehicle that uses sinkage wheels and a plow to test soil strength data, and records bottom conditions with both still and TV cameras and other instruments, offers many advantages to engineers planning ocean-bottom installations. Vehicle instrumentation and ship control and monitoring functions for data acquisition are described. Data sampled at random by this device off Newfoundland and New Jersey are compared. Wheel sinkages, together with core samples, suggest that the Newfoundland area is characterized by a weak glacial till with occasional boulders, and the New Jersey shelf by old beach levels. Pitch and roll data are confirmed by photographs.—GDC

02432 **Repenning, Charles A.** Subfamilies and genera of the Soricidae: U.S. Geol. Survey Prof. Paper 565, 74 p., illus., 1967.

The shrews, a family distinct from all other insectivores, is comprised of five recognizable subfamilies: (1) Heterosoricinae—extinct, known from the northern hemispheres, early Oligocene-early Pliocene; (2) Crocidurinae (white-toothed shrews)—living, evolved south of Tethys seaway, Oligocene-present; (3) Limnoecinae—extinct, North America, early Miocene-early Pliocene; (4) Soricinae (red-toothed shrews)—living, evolved in Eurasia, then to North America (early Miocene) and South America (Pleistocene); (5) Allosoricinae—extinct, Europe, late Miocene-late Pliocene. With certain limitations involving lineage of the shrew and the geographic area under consideration, the Soricidae now contribute a new tool for use in geochronology and intercontinental correlation.—LLP

02458 **Repenning, Charles A.** Palearctic-Nearctic mammalian dispersal in the late Cenozoic, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 288-311, tables, 1967.

Exotic faunal elements are becoming the most respected criteria in biostratigraphic age assignment. The late Cenozoic mammalian faunas of North America—Hemphillian, Blancan, Irvingtonian, and Rancholabrean—are compared with those of the Old World to establish the reliability of temporal correlations based on fauna and isotopic ages, and to determine what mammals were involved in these intercontinental exchanges and their significance for the Bering land bridge. Conventional assignment of glacial ages to mammalian faunas and suggested Nearctic-Palearctic faunal correlations are also tabulated. Records of the mammals involved in dispersals suggest that the environment of the land bridge ranged from warm-temperate and forested in Hemphillian to arctic tundra in Rancholabrean.—ESL

02798 **Rexroad, Carl B.; Orr, R. William.** Silurian and Devonian stratigraphy of southeastern Indiana, Field Trip 2 *in* Geologic tales along Hoosier trails—Geol. Soc. America, North-Central Sec., 1st Ann. Mtg., 1967, Field Trip Guidebook:

Bloomington, Ind., Indiana Univ. Dept. Geology and Indiana Geol. Survey, p. 39–74, illus., 1967.

This trip, in the vicinity of Columbus, Madison, and Falls of the Ohio, covers the stratigraphic sequence from the Brassfield Limestone, at the base of the Silurian, to the Upper Devonian New Albany Shale. Usefulness of conodonts in regional correlation is demonstrated. Gross relationships within the field trip area are shown in cross sections. Regional correlation charts for Silurian and Devonian units are given. Descriptions of measured sections in the area are modified from other authors.—VMJ

02861 **Reynolds, R. C., Jr.; Anderson, D. M.** Cristobalite and clinoptilolite in bentonite beds of the Colville Group, northern Alaska: Jour. Sed. Petrology, v. 37, no. 3, p. 966–969, tables, 1967.

Cristobalite occurs in some bentonites in coal-bearing sequences and clinoptilolite occurs in bentonites in both coal-bearing sequences and in marine shale. The minerals are the result of post-depositional formation of bentonite.—HAT

02545 **Rhoades, James David.** Interstratification tendencies of trioctahedral vermiculite and biotite produced by ion exchange equilibrations [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 4050B–4051B, 1967.

02892 **Rhoads, Donald C.** Biogenic reworking of intertidal and subtidal sediments in Barnstable Harbor and Buzzards Bay, Massachusetts: Jour. Geology, v. 75, no. 4, p. 461–476, illus., tables, 1967.

Reworking of intertidal sediment in Barnstable Harbor by the ingestion and transportation of sand by three tube-dwelling polychaete species is primarily a vertical and lateral size-sorting process resulting in biogenically graded deposits. These polychaetes rework from 274 to more than 400 ml of sediment per worm per year; disturbance is most intense in the upper 10 cm, but extends to a depth of 30 cm. Sediment from a water depth of 18 m in Buzzards Bay is extensively reworked in the upper 2–3 cm but not below 10 cm, mainly by two mollusc and one polychaete species. Observed maximum depths of burrowing to 10 cm or 30 cm in ancient sediments may be used to differentiate intertidal or subtidal depositional environments, respectively.—VES

02721 **Rice, Charles L.** Geologic map of the Prestonsburg quadrangle, Floyd and Johnson Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-641, scale 1:24,000, section, text, 1967.

Principal resources of the Prestonsburg quadrangle, which is within the Big Sandy gas field, are gas and oil. Most gas comes from the Ohio Shale which is about 500 feet below sea level in the northwest and about 900 feet in the southeast. Small quantities of oil are found also, but none is produced commercially. Coals are high-volatile A bituminous, in beds highly variable in thickness, commonly containing shale partings, and seldom more than 28 inches thick. Other resources include alluvial sand and gravel along larger streams, and some shale.—MCM

Richards, Horace G. *See* Fairbridge, Rhodes W. 02824

02654 **Richardson, S. W.; Bell, Peter M.; Gilbert, M. Charles.** Kyanite-sillimanite relations: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 247–248, illus., table, 1967.

The authors here report the results of experiments similar to those of Newton (1966) in a hydrothermal study of kyanite-sillimanite boundary which indicated that much lower pressures are sufficient for the stable growth of kyanite. The authors used a gas-pressure apparatus in which the hydrostatic pressure may be measured very accurately. The results agree within the limits of experimental error with Newton on the pressure of the inversion at 750°C. The data show that kyanite does not require extreme pressure for its formation and it may be possible to set upper pressure limits on regional metamorphism in specific areas.—MST

02655 **Richardson, S. W.** Staurolite: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 248–252, illus., 1967.

The composition of staurolite is imperfectly known. Experimental determinations of the stability of Fe and Fe–Mg staurolite in various combinations with excess quartz and muscovite under controlled H_2O AND O_2 pressures should provide successively more realistic estimates of the temperature interval over which this mineral can occur in nature. Experiments reported here bear on the upper thermal stability limit of Fe staurolite, the composition of this mineral, and the effect of Mg for Fe substitution on the unit cell dimensions. With use of synthetic crystalline starting materials buffered with quartz–fayalite–magnetite, the high temperature stability limit of Fe staurolite has been determined to 10 kb.—MST

02898 **Richter, Donald H.** Geological and geochemical investigations in the Metal Creek area, Chugach Mountains, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 25, 17 p., illus., tables, 1967.

The principal country rock of the Metal Creek area in south-central Alaska is Cretaceous interbedded slate, siltstone, and graywacke locally metamorphosed to phyllite and quartz mica schist. Andesitic volcanics crop out and narrow quartz diorite dikes are common. A raised glacial terrace extends up Metal Creek and glacial debris mantles the high valleys. The sedimentary rocks are tightly folded and dip steeply northeast. Quartz veins with minor pyrite and chlorite are common, and some veins have minor pyrrhotite and chalcopyrite. Placer gold, mined intermittently since 1906, is apparently being reworked from terrace glacial deposits. Of the 79 streams sampled, no trace elements were detected, but heavy mineral concentrates indicate anomalous scheelite concentrations.—LLP

02618 **Rietman, Jan David.** Remanent magnetization of the Late Yakima Basalt, Washington State [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3569B–3570B, 1967.

Riley, L. B. *See* Huffman, Claude, Jr. 02434

Rinehart, John S. *See* Nicholls, Harry R. 02445

02791 **Ritchot, Gilles.** Problèmes géomorphologiques du Québec méridional—Pt. 1, Le mont Royal, esquisse géomorphologique [with English and French abs.]: Rev. Géographie Montréal, v. 21, no. 1, p. 41–79, illus., 1967.

Mount Royal, a residual massif, rises eastward to an elevation of 200 m overlooking the Montreal platform. Hard rock cores frame slope knobs that dot the step-faulted piedmont. The cores of two inselbergs flanking the southern margin cut metamorphic limestones of Paleozoic age. As a whole the crystalline rocks resisted the neotectonic foldings of the surrounding limestones, but a spur was dislocated by a Pliocene monoclinal flexure which deformed the eastern part of the Island of Montreal. The neotectonic massif has been deeply weathered, its relict soils denoting subarid climate. Old inset pediments lie on the western part which was remodeled by early Quaternary glaciers. Periglacial processes shaped altiplanation terraces on the eastward pediment.—GDC

02881 **Ritchot, Gilles.** Problèmes géomorphologiques du Québec méridional—Pt. 3, Cartes géomorphologiques de la plate-forme de Montréal [with English abs.]: Rev. Géographie Montréal, v. 21, no. 1, p. 168–169, illus., geol. maps, 1967.

The St-Benoit and Terrebonne map sheets (in pocket) were prepared at the University of Strasbourg by cartographic methods based on those of the Polish geographical school. The outstanding feature is the genetic base of the legend, classifying landforms in symbols by morphogenetic episodes in color. A good understanding of the morphogenesis of the area is a prerequisite to map preparation. Different colors, for example, represent glacial forms, post-glacial bluffs, Tertiary rock floors and residual hills, and marine clay plains. Two symbols may bear the same color, or one symbol may appear in two shades, for superposition of complex forms and chronology of processes. Pastel tints indicate lithology, and dark colors age; tectonic data are in black. The St. Benoit sheet is described in detail.—GDC

02594 **Ritter, John R.** Bed-material movement, Middle Fork Eel River, California, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C219-C221, illus., table, 1967.

The Middle Fork Eel River, at a discharge of about 3,750 cfs and an average velocity of about 6 fps, moved bed material of cobble size. The size of the transported material was determined by actually noting, through the use of photographs, which individual rocks had been removed from painted areas on the riverbed; particle size of these rocks is proportional to average velocity and to tractive force.—Author's abstract

02927 **Rivard, L. A.** The contribution of air photo interpretation to the planning and development of hydro-electric resources in the Province of Newfoundland, Labrador (Canada) [with French, German, and Spanish abs.], *in* Symposium Internat. Photo-interprétation, 2d, Paris, 1966, Actes: Paris, Éditions Technip, p. IV.1-123—IV.1-132, illus., 1967.

The background of the British Newfoundland Corporation as a Canadian resource development organization is discussed briefly. The Churchill Falls Power Project in Labrador involves creation of a reservoir by building a series of dikes at low levels along rims of lakes, location of plant sites, and diversions of the river. A soils classification system covering Pleistocene and Recent unconsolidated deposits of central Labrador is presented, and physical characteristics of the area and engineering problems of some distinctive units are examined. Examples of applications of airphoto interpretation are given for location of fill material, routes for road and transmission line, and site location with relation to depth to bedrock.—GDC

Roberson, C. E. *See* Polzer, W. L. 02480

Roberson, C. E. *See* Hem, J. D. 02826

Roberts, Albert E. *See* Maughan, Edwin K. 02431

02975 **Roberts, Ralph J.; Montgomery, Kathleen M.; Lehner, Robert E.** Geology and mineral resources of Eureka County, Nevada: Nevada Bur. Mines Bull. 64, 152 p., illus., tables, geol. map, 1967.

The mountain ranges of Eureka County are underlain mostly by two facies of Cambrian-Early Mississippian preorogenic sedimentary rocks; Mississippian-Permian postorogenic clastics overlap these facies. Mesozoic and Tertiary volcanic and sedimentary rocks and Quaternary alluvium are present also. Paleozoic formations were folded in Late Devonian or Mississippian, and the western assemblage moved eastward on the Roberts Mountains thrust. Orogenic movements occurred in late Paleozoic and Mesozoic, and granitic stocks were emplaced in the Mesozoic and Tertiary. The associated ore deposits are mainly silver-gold-lead-zinc in the eastern assemblage and gold, copper, and barite in the western assemblage. Iron ore and silver have been produced from deposits in volcanic rocks. Recorded metal production for the county was more than 78 million dollars up to the end of 1966.—LLP

Rodda, Peter U. *See* Fisher, W. L. 02951

02555 **Rogers, C. L.; Anderson, R. E.; Ekren, E. B.; O'Connor, J. T.** Geologic map of the Quartzite Mountain quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-672, scale 1:62,500, sections, 1967.

02748 **Rogers, Lowell Thompson.** Availability and quality of ground water in Fayette County, Texas: Texas Water Devel. Board Rept. 56, 117 p., illus., tables, geol. map, 1967.

Fayette County is on the upper Gulf Coastal Plain in east-central Texas. Ground water is pumped principally from the Sparta Sand, Yegua Formation, sands in the upper Jackson Group, the Catahoula Tuff, Oakville Sandstone, and Lagarto Clay; it is generally of good quality and suitable for most purposes. The Carrizo Sand,

Queen City Sand, and sands of the Wilcox Group contain fresh to slightly saline water that is not being utilized. It is estimated that the Catahoula Tuff, Oakville Sandstone, and Lagarto Clay are capable of transmitting 19,000 acre-feet annually, the Sparta Sand up to 16,000 acre-feet, and the Carrizo Sand about 20,000 acre-feet.—LLP

02998 **Rogers, Thomas H.** Active extensional faulting north of Hollister near the Calaveras fault zone: Seismol. Soc. America Bull., v. 57, no. 4, p. 813–816, illus., 1967.

Two active en echelon faults were discovered during recent geologic mapping, about 1,500 feet west of the Calaveras fault zone some seven miles north of Hollister, Calif. Vertical movement on these faults since 1960 has caused displacements of 0.2–0.6 feet in a driveway, concrete walk, wood frame house, and several fences on property on Shore Road; Shore Road itself, a paved county road, has been displaced by an unknown amount. No horizontal components of movement were evident.—DBV

02874 **Rooney, Lawrence F.; French, Robert R.; Hutchison, Harold C.** Nonmetallic mineral resources of southwestern Indiana, Field Trip 4 *in* Geologic tales along Hoosier trails—Geol. Soc. America, North-Central Sec., 1st Ann. Mtg., 1967, Field Trip Guidebook: Bloomington, Ind., Indiana Univ. Dept. Geology and Indiana Geol. Survey, p. 77–133, 1967.

Limestone quarries, a dimension-stone mill, gypsum mines, and a strip coal mine are visited, near Bedford, Orleans, Shoals, and Pleasantville. The lower Upper Mississippian Salem Limestone ("Indiana Limestone," world-famous as a dimension stone) crops out in a northwest-trending belt; current production is centered in Lawrence and Washington Counties. The Upper Mississippian Ste. Genevieve and Paoli Limestones, cropping out west of the Salem, are important sources of industrial limestones and aggregate. Gypsum and anhydrite are mined from the lower St. Louis Limestone; a map shows subsurface distribution of the evaporites. Coal members of the Middle Pennsylvanian Carbondale Group are strip-mined near Pleasantville. Description of a composite section of Mississippian rocks was prepared from unpublished data.—VMJ

02900 **Rose, E. R.** Discussion—Rb/Sr age and geological setting of the Holyrood granite, southeast Newfoundland, by W. D. McCartney, W. H. Poole, R. K. Wanless, H. Williams, and W. D. Loveridge [1966]: Canadian Jour. Earth Sci., v. 4, no. 4, p. 746, 1967.

The proposition expressed in the 1966 paper by McCartney *et al* (ibid., v. 3, p. 947–957, 1966), requires that the major part of the Precambrian be compressed within the span of 15 m.y., despite a margin of error of ±11 m.y., which seems unreasonable in view of the events involved. Two alternative solutions are offered, the more plausible being that granitic pebbles found in the Conception Group might have been from a granite older than the Holyrood body. Isotopic dating of sets of granite pebbles from the Conception and Cabot Group conglomerates is suggested as a check.—ESL

Rose, Harry J. *See* Skinner, Brian J. 02694

02473 **Ross, David A.** Heavy-mineral assemblages in the nearshore surface sediments of the Gulf of Maine, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C77–C80, illus., tables, 1967.

Nearshore sediments adjacent to the mouths of three rivers entering the Gulf of Maine have heavy-mineral suites similar to those in the rivers. The heavy-mineral assemblages found both in the rivers and in the adjacent nearshore areas correspond with those expected from the rocks exposed in the drainage areas of the rivers. The distribution of the light-mineral components, although not diagnostic in differentiating between source areas, is helpful in understanding environments of deposition. These sediments are interpreted as Recent in origin, whereas the sediments farther offshore are presumably Pleistocene or glacial in origin.—Author's abstract

02522 **Roy, J. L.** The Dominion Observatory astatic magnetometer, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 69–74, illus., tables, 1967.

The construction and performance of an astatic magnetometer is given. It is shown that the use of a fluxgate system to maintain a steady field-free space at the magnetometer greatly reduces the noise level.—Author's summary

02532 **Roy, J. L.** Shape and size of weakly magnetized rock specimens, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 192–195, illus., 1967.

A brief description of various methods of measurement by means of an astatic magnetometer is given. A variation study of the relative dimensions of a cylindrical specimen indicates that improved response of the magnetometer can be obtained by choosing the height of the specimen approximately equal to twice its radius.—Author's abstract

Roy, Robert F. *See* Bell, Peter M. 02689

02757 **Royse, Chester F., Jr.** Mazama ash from the continental slope off Washington: Northwest Sci., v. 41, no. 3, p. 103–109, illus., tables, 1967.

Sedimentologic studies of a core from a bench in Willapa submarine canyon off southern Washington showed an ash layer at a depth of 240 cm. The core represents a sequence of continuous deposition. The age of the ash, calculated from C-14 dates elsewhere in the core, is about 7,360 yr; texture and sorting indicate that the layer is the product of a single eruption at some distance. Of the numerous ash falls recognized in the Northwest, only those of Glacier Peak and Mount Mazama are of extreme regional extent, the latter overlapping the former. The ash layer in the core is considered to be Mazama on the basis of age and refractive index, and extends distribution of this ash about 100 miles westward.—ESL

Rusnak, G. A. *See* Yerkes, R. F. 02476

02474 **Rusnak, Gene A.** High-efficiency subbottom profiling, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C81–C91, illus., 1967.

Difficulty because of side echoes and their multiple reflections when making seismic subbottom profiles in narrow fiords . . . can be overcome by beamforming, or focusing, with suitable source and receiver geometry. A multiple-electrode sparker system increases sound-source propagation area and improves signal directivity. Signal directivity is achieved by the additive nature of reflected signals whose travel time is equidistant from the source. A four-unit sparker system in a square planar format, with discharge units spaced at half a wave length from each other and a quarter of a wave length from the water surface, improves the signal and directivity and increases resolution. Freefield measurement with a calibrated hydrophone is planned for experiments to provide a quantitative evaluation of the apparent gains so far observed qualitatively. [Examples are given from Alaska and California.]—Author's abstract

Sadeh, Dror. *See* Kane, Julius. 03014

02456 **Sainsbury, C. L.** Quaternary geology of western Seward Peninsula, Alaska, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 121–143, illus., tables, 1967.

Two wave-cut terraces are the main geomorphic units of western Seward Peninsula. York terrace bevels limestone beds and varies in width from a few hundred meters to almost eight kilometers; cutting was completed during the Yarmouth(?) Interglacial. Lost River terrace, whose sea cliffs mark the seaward boundary of York terrace, is from 30 to 5,000 m wide and of Sangamon age; it is covered by

alluvial fans, deltaic deposits, etc. Quaternary deposits include cemented conglomerate on the York terrace, unconsolidated deposits on the Lost River terrace, drift of the York and Mint River glaciations, alluvial fans, and stream terrace gravels. It is probable from the Quaternary history that any animal migrations across Bering Strait were restricted to Wisconsin time, and then only under difficult conditions. Evidence of earlier migrations should be sought south of the Strait.—ESL

02872 **Sammel, E. A.** Water resources of the Parker and Rowley River basins, Massachusetts: U.S. Geol. Survey Hydrol. Inv. Atlas HA-247, scale 1:24,000, separate text, 1967.

Pleistocene aquifers in the Parker and Rowley River basins are in outwash and ice-contact deposits, and till. Maximum yields from wells are 500 gpm in ice contact, about 75 in outwash, and 100 in marine deposits and bedrock. Wells in bedrock are often deepened below the level at which water is encountered to provide storage; depths in unconsolidated materials are normally determined by depths of the most permeable zone in the aquifer. Natural waters in the basins are generally suitable for domestic use. Future development of large supplies will be limited by indicated rates of recharge, and by rates at which water can be yielded to individual wells at a given site.—MCM

02482 **Sandberg, Charles A.; Mapel, William J.; Huddle, John W.** Age and regional significance of basal part of Milligen Formation, Lost River Range, Idaho, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C127-C131, illus., 1967.

A conodont fauna assigned to the Lower *Siphonodella crenulata* Zone (lower *cu*IIa), which is indicative of an Early Mississippian (Kinderhook) age, was found 13 feet above the base of the Milligen Formation near Mackay, Idaho. The conodonts are the first pre-Permian conodonts reported from Idaho and the first diagnostic fossils recovered from the Milligen. The fauna is identical with that in the basal part of the Lodgepole Limestone near Logan, in southwestern Montana. The occurrence of this fauna so far west of Logan and so near the Idaho batholith proves that the Milligen is no older than Mississippian in most of east-central Idaho.—Authors' abstract

02830 **Sanders, J. V.; Dietz, R. W.** Precious opal from California: Gems and Minerals, no. 360, p. 16-19, illus., 1967.

Electron microscopy of some California gem opals reveals that, like Australian opals, they are composed of uniform silica particles packed regularly together, but they do not contain the clearly defined voids between particles. Since American opals show a good play of color, it is postulated that there is some change in refractive index associated with each particle, and due to the regular arrangement, light is reinforced in certain directions. The absence of voids in American opals must be associated with differences in formation conditions.—LLP

02852 **Saraf, D. N.; Fatt, I.** Three-phase relative permeability measurement using a nuclear magnetic resonance technique for estimating fluid saturation: Soc. Petroleum Engineers Jour., v. 7, no. 3, p. 235-242, illus., 1967.

A method is described for measuring two- and three-phase relative permeabilities in sandstones or sand packs using a nuclear magnetic resonance (NMR) technique to determine fluid saturations. Two- and three-phase relative permeabilities have been determined on Boise sandstone using the NMR technique of saturation measurement. Three-phase relative permeability to water was found to depend only on the water saturation, whereas three-phase permeability to oil depended on both the water and oil saturations. Relative permeability to gas in three-phase flow was found to depend only on the total liquid saturation.—Authors' abstract

02971 **Sarcia, Jacqueline.** Gitologie prévisionnelle et géochronologie—Distribution géochronologique des principales minéralisations du Bouclier canadien: [France] Bur. Recherches Géol. et Minières Bull. 1967, no. 2, p. 75-79, illus., 1967.

Comparison of the numerous published radioactive ages and production of minerals in the Canadian Shield shows that most of the metals are located almost exclusively in certain geochronologic provinces. The Archean has produced 30 times as much gold, 6 times as much copper, 4 times as much zinc, and as much silver as the lower Proterozoic. From the latter comes all platinum, almost all cobalt, most of the nickel, and the uranium. Copper appears in the Keweenawan lavas; other mineralization is tied to the Grenville orogenesis. Known mineral resources are situated in or near geochronologic anomalies. Radioactive ages could be a rapid method of deciphering geologic history and structure of a region, and of prospecting in an unknown area, or one difficult for traditional methods.—ESL

02576 **Sarmah, Suryya Kanta.** Attenuation of compressional waves in the Earth's mantle [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3998B, 1967.

02468 **Sato, Yoshiaki; Denson, N. M.** Volcanism and tectonism as reflected by the distribution of nonopaque heavy minerals in some Tertiary rocks of Wyoming and adjacent states, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575–C, p. C42–C54, illus., table, 1967.

Tertiary rocks in the middle Rocky Mountains and northern High Plains contain two distinct assemblages of nonopaque heavy minerals. A volcanic assemblage is characterized by oxy- and green-brown hornblende, augite, hypersthene, and red-brown biotite, and generally constitutes 60–70 percent of the nonopaque heavy minerals in lower Miocene rocks (Arikaree Formation). A plutonic assemblage is characterized by blue-green hornblende, garnet, epidote, sillimanite, sphene, tourmaline, zircon, and gray-green biotite and generally constitutes more than 55 percent of the nonopaque heavy minerals in middle Tertiary, Oligocene (White River Formation), and upper Miocene and Pliocene rocks (Ogallala Formation). These heavy-mineral assemblages substantiate postulated regional Tertiary geologic history and aid in correlating units throughout the northern High Plains.—Authors' abstract

Sawkins, F. J. *See* Davidson, C. F. 02903

02674 **Scarfe, C. M.; Wyllie, P. J.** Serpentine dehydration curves and their bearing on serpentinite deformation in orogenesis: Nature, v. 215, no. 5104, p. 945–946, illus., 1967.

A study was made of serpentine stability in the system MgO–FeO–Fe_2O_3–SiO_2–H_2O in which oxygen fugacities were buffered, paying particular attention to attainment of equilibrium and reversal of reactions. Results of these phase equilibrium experiments are consistent with the proposal of Raleigh and Patterson (1965) that the weakening of serpentine is caused by liberation of water during dehydration. The presence or absence of brucite in serpentinite may provide an important control on the various tectonic processes.—DBV

Schairer, J. F. *See* Tilley, C. E. 02629

02657 **Schairer, J. F.; Yoder, H. S., Jr.** The system albite–anorthite–forsterite at 1 atmosphere: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 204–209, illus., 1967.

The results of the authors' investigation of the system albite–anorthite–forsterite at 1 atmosphere pressure are presented. An equilibrium diagram for albite–forsterite–anorthite at 1 atmosphere with isotherms is given and described. Isotherms for 1280°C and for 1300°C are figured and described.—MST

02714 **Schairer, J. F.; Yoder, H. S., Jr.; Tilley, C. E.** The high-temperature behavior of synthetic melilites in the join gehlenite–soda melilite–akermanite: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 217–226, illus., 1967.

The melilites are major constituents of many basic alkaline rocks. The authors have studied the stability relations at high temperatures of pure akermanite and of akermanite in the presence of excesses of its constituent oxides, the relations between akermanite and soda melilite and between gehlenite and soda melilite, the two joins nepheline–akermanite–$CaSiO_3$ and nepheline–gehlenite–$CaSiO_3$, and the

"ternary" melilite join gehlenite–soda melilite–akermanite. Results of observations of the behavior of two analyzed natural melilites from basic alkaline rocks at various temperatures are summarized.—MST

Schalk, Marshall. *See* Hume, James D. 02680

02755 **Scharff, Robert.** (editor). Yosemite National Park: New York, David McKay Co., 213 p., illus., tables, 1967.

This handbook guide to Yosemite National Park, Calif., includes a description of the geology of the park, its natural history, and special topographic and geologic features. Also described are the wildlife, plants, trails and roads, accomodations, and services in the park.—LLP

02422 **Scheffer, Victor B.** Marine mammals and the history of Bering Strait, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 350–363, tables, 1967.

Of the 116 species of marine mammals, 16 are reviewed in detail, concentrating on those that enter the Bering–Chukchi region or could have during the late Cenozoic. Four marine mammal traits have implications for population spread: some are migrant, individuals may stray far from home, all pinnipeds are able to travel on land and ice, and many mammals are antitropical. The Pleistocene series of land and ice barriers shaped the evolution of subspecies of six mammals. The Pacific and Atlantic stocks of whales and porpoise do not appear to be different. Since some mammals are found only in one ocean, it may be that cold water acts as a barrier.—ESL

Schell, Elmer M. *See* Pampeyan, Earl H. 02896

Schenk, P. E. *See* Campbell, F. H. A. 02823

02942 **Schmincke, Hans-Ulrich.** Flow directions in Columbia River basalt flows and paleocurrents of interbedded sedimentary rocks, south-central Washington: Geol. Rundschau, v. 56, no. 3, p. 992–1020, illus., tables, 1967.

Flow directions in the upper 12 Yakima Basalt flows indicate fairly uniform transportation direction from southeast to northwest, supporting the idea that the Grande Ronde–Cornucopia dike swarm in northeastern Oregon was the source of the lava. Study of sediments interbedded with the basalt sheets delineates two main paleoslopes whose deposits interfinger. The opposed transport directions of the basalts and sediments is due to the fact that during the outpouring of the lower basalts, very fluid lavas were able to overcome gentle opposed slopes. Later the southwest gradient of the ancestral Columbia River became more pronounced, so that the two youngest basalts turned and flowed southwest to meet the Columbia paleoslope.—DBV

02880 **Schneider, Allan F.; Wayne, William J.** Pleistocene stratigraphy of west-central Indiana, Field Trip 3 *in* Geologic tales along Hoosier trails—Geol. Soc. America, North-Central Sec., 1st Ann. Mtg., 1967, Field Trip Guidebook: Bloomington, Ind., Indiana Univ. Dept. Geology and Indiana Geol. Survey, p. 75–103, 1967.

The main objective of this trip, in the vicinity of Bloomington, Cataract Lake, Mansfield Reservoir, and Crawfordsville, is to show the known sequence of glacial and interglacial deposits, which include Kansan, Illinoian, possibly three pre-Cary Wisconsin tills, Yarmouth and Sangamon weathering profiles, interglacial and interstadial flood-plain sediments, and three loesses, the youngest designated the Peoria. A secondary purpose is to demonstrate the theoretical and practical factors involved in Wayne's (1963) stratigraphic classification of Pleistocene sediments in Indiana. Descriptions of measured sections are modified from Wayne (1963, 1965). Glacial and inherited geomorphic features, including karst, are also observed.—VMJ

02976 **Schneider, William P.** Two new developments from Project Mohole research—1, A short baseline system for dynamic positioning; 2, Sonar system for hole re-entry: Ocean Industry, v. 2, no. 6, p. 15–25, illus., 1967.

The most difficult task involved in the Mohole Project effort was to be the drilling and sampling of the unknown layers of the Earth's crust and underlying mantle. In 1962, there was no equipment which could reach the projected depths, no ocean going vessel large enough to provide island-like stability for the long range drilling program, and no measurement systems that could assure accurate scientific data from penetration of the crust and mantle. When the project was cancelled, 1966, the partially completed drilling platform had to be scrapped; but many of the electronic and sonar systems had been virtually completed. The two new developments described here could be used in programs now shaping up in marine sciences.—GDC

Schnepfe, Marian M. *See* Grimaldi, F. S. 02485

Schoen, Robert. *See* Ehrlich, Garry G. 02478

03028 **Schramm, Martin W., Jr.** Application of trend analysis to pre-Morrow surface, southeastern Hugoton embayment area [abs.]: Shale Shaker, v. 18, no. 1, p. 16, 1967.

Schroeder, Marvin L. *See* Pampeyan, Earl H. 02896

02684 **Schumann, S. A.** Meander length of alluvial rivers: Science, v. 157, no. 3796, p. 1549-1550, illus., 1967.

Data on river channel and sediment characteristics were collected at 36 cross sections of stable alluvial river channels in Australia and western United States. These data demonstrate that the meander wavelength of a river is dependent not only on water discharge, but also on the type of sediment load moved through the channel. The meander wavelength of rivers that are transporting a high proportion of their total sediment load as both sand and gravel will be greater than the meander wavelengths of channels of similar discharge which are transporting mainly fine sediment loads.—Author's abstract

02722 **Schweinfurth, Stanley P.** Geologic map of the California quadrangle, Washington and Fayette Counties, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-648, scale 1:24,000, section, text, 1967.

In the California quadrangle coal has been mined on a large scale, oil and gas have been produced on a small scale, and limestone and sandstone have been quarried for local use. Principal coal beds are the Pittsburgh, Redstone, and Waynesburg. Gas has been produced for more than 75 years from subsurface sandstone beds of Mississippian and Devonian ages; however, oil production has been very small. Limestone, used locally for agricultural lime, road surfacing, and building, has been quarried principally from the Sewickley Member of the Pittsburgh Formation. Sandstone, for road surfacing and building stone, has been quarried mainly above the Pittsburgh and Waynesburg coal beds.—MCM

Scott, B. Smithson. *See* Bott, M. H. P. 02491

Scott, Ronald F. *See* Ko, Hon-Yim. 02711

Scott, William H. *See* Hansen, Edward. 02715

Seed, H. Bolton. *See* Lee, Kenneth L. 02709

02761 **Seed, H. Bolton.** Earthquake-resistant design of earth dams, *in* Papers presented at the 19th Canadian Soil Mechanics Conference, Pt. 1: Canadian Geotech. Jour., v. 4, no. 1, p. 1-27, illus., tables, 1967.

Very few major dams have been subjected to very strong shaking by earthquakes. The Sheffield Dam in Santa Barbara, Calif., failed during a local earthquake in 1925, and another near Anchorage failed during the 1964 Alaskan earthquake. The Hebgen Dam in Montana has been used as an example of a dam that held although near a major fault, but it was only a fortunate combination of circumstances that kept it from failing. Ways in which earthquakes may cause dam failures are listed

and design measures discussed. Past slope-stability evaluation has involved use of pseudostatic and elastic response analyses to determine the seismic coefficient. Limitations of these methods are examined and some new developments in analysis of slope stability during earthquakes are given; their use on Oroville Dam, Calif., is cited as an example.—ESL

02688 **Seilacher, Adolf.** Fossil behavior: Sci. American, v. 217, no. 2, p. 72–80, illus., 1967.

Fossil tracks or burrows (trace fossils) may be classified according to the animal that is thought to have made them and according to interpreted function, such as simple motion, foraging, feeding burrows, "resting" tracks, and dwelling burrows. Where such tracks are thought to be made by a specific type of animal, they commonly show a change in the behavioral pattern of the animal toward more efficient food gathering techniques. Several unrelated groups of trace fossils provide evidence that the progress from simple to complex forms of foraging is an evolutionary one.—DWR

Senftle, F. E. *See* Donnay, Gabrielle. 02638

Senftle, F. E. *See* Donnay, Gabrielle. 02650

02700 **Service, A. L.; Peterson, N. S.** An evaluation of the western phosphate industry and its resources (in five parts)—[Pt.] 5, Trends and outlook: U.S. Bur. Mines Rept. Inv. 6935, 131 p., illus., tables, 1967.

World phosphate resources are contained in deposits of four types: igneous apatites, marine phosphorites, phosphatized rock, and guano. Marine phosphorites are the most important, supplying at least 80 percent of world phosphate production. The United States is the major world producer, followed in order by the U.S.S.R., Morocco, and Tunisia. Deposits in Florida, Tennessee, and the western field (Idaho, Montana, Wyoming, Utah) account for U.S. production. Both domestic and world production is expected to increase, with minor shifts in the present pattern of supply. The economic geology of the principal phosphate deposits of the world is summarized, and production, exports, and resources tabulated. Domestic extraction, transportation, and refining technology are described.—KFF

Service, A. L. *See* Coffman, J. S. 02701

Shafiqullah, M. *See* Currie, K. L. 02793

Shaw, David M. *See* Donn, William L. 02834

02433 **Shawe, D. R.; Poole, F. G.; Brobst, D. A.** Bedded barite in East Northumberland Canyon, Nye County, Nevada: U.S. Geol. Survey Circ. 555, 8 p., illus., tables, 1967.

Bedded barite has been identified in the course of stratigraphic studies by the U.S. Geological Survey in and near East Northumberland Canyon, Toquima Range, Nye County, Nev. The barite beds are interlayered in black chert of probable Ordovician age. The barite rock is mostly dark gray and massive, has a specific gravity averaging about 4.0, and contains, by chemical analysis, 70.7 to 93.9 percent $BaSO_4$.—Authors' abstract

02877 **Shepard, F. P.** Reply [to presentation of Wollaston Medal]: Geol. Soc. London Proc. 1965–66, no. 1634, p. 139–140, 1967.

In response to Professor Shotton's reference to his retraction of the sea-level lowering hypothesis of submarine canyons, Shepard admitted it was not the first time he was wrong, and that changing ideas relieve the monotony of supporting the same old ones. Other types of currents combined with mass movements may explain the canyons. In regard to the statement "The present is the key to the past", many ancient sedimentary formations have no counterparts in collections from the ocean floor, owing to the unstable sea level of the last million years. Another difficulty has come from describing all sorts of formations as turbidites,

with only circumstantial evidence. Drilling into the sea floor below coring depths has just begun; there are many types of deltas from which sediments are virtually unknown. In forming new hypotheses, an open mind should not disregard facts gathered with great effort in the past.—GDC

02928 **Shepard, Francis P.** The Earth beneath the sea (revised edition): Baltimore, Md., Johns Hopkins Press, 242 p., illus., 1967; originally published 1959.

This second edition, revised since 1959 to include additional material, maps, diagrams, and photographs, is an introduction to submarine geology in which recent underwater research is related to the established principles of this field of science. The 11 chapters are: waves and currents modify the sea floor, catastrophic waves from the sea, our transient beaches, the continental shelves that surround the lands, origin of continental shelves, the world's greatest slopes, canyons of the sea floor, the deep-ocean floor, under the ocean bottom, coral reefs and their undersea wonderlands, and using the present sea-floor deposits to interpret the past.—LLP

02469 **Sheppard, Richard A.** Petrology of a late Quaternary potassium-rich andesite flow from Mount Adams, Washington, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C55-C59, illus., table, 1967.

A single thick flow of augite hypersthene andesite crops out in the Klickitat River canyon. The flow is characterized by an upper dark-gray vesicular zone that is succeeded downward by a light-gray platy and massive zone, and then a columnar zone. Chemical analyses indicate that the andesite contains more K_2O and TiO_2 and less MgO than most andesites of similar SiO_2 content from other volcanoes of the High Cascade Range.—Author's abstract

Shepps, Vincent C. *See* Tomikel, John C. 02747

02768 **Sheridan, Douglas M.; Maxwell, Charles H.; Albee, Arden L.; VanHorn, Richard.** Geology and uranium deposits of the Ralston Buttes district, Jefferson County, Colorado: U.S. Geol. Survey Prof. Paper 520, 121 p., illus., tables, geol. maps, 1967.

Precambrian metamorphic and igneous rocks form the bedrock in 90 percent of the district. They are overlain unconformably in the northeastern part by Paleozoic and Mesozoic sedimentary rocks. Major structural events include: two periods of Precambrian plastic deformation accompanied by regional metamorphism to high-grade facies; a period of Precambrian cataclastic deformation; probable late Precambrian faulting along northwest trends; Late Cretaceous to early Tertiary uplift accompanied by renewed movements along fault systems and deposition of hydrothermal veins in openings in fault breccias. Pitchblende is the principal ore mineral in the veins. Some veins are epithermal, others are transitional to mesothermal. The district has become the most important uranium mining district in the Colorado Front Range.—Authors' abstract

02895 **Shotwell, J. Arnold.** *Peromyscus* of the late Tertiary in Oregon: Oregon Univ. Mus. Nat. History Bull. 5, 35 p., illus., tables, 1967.

Samples of *Peromyscus* from six late Tertiary localities in Oregon are described. Variation and progressive changes are discussed for the time, Barstovian through Hemphillian. Two new species, *P. pagei* and *P. valensis* are described. The diversity of late Tertiary species in Oregon and the Northern Great Basin is compared with that of living species in North America today.—Author's abstract

02839 **Siever, Raymond; Kastner, Miriam.** Mineralogy and petrology of some Mid-Atlantic Ridge sediments: Jour. Marine Research, v. 25, no. 3, p. 263-278, illus., tables, 1967.

Coarse and fine fractions of samples from dredge hauls and cores taken in a detailed survey in the area of 22° N. on the Mid-Atlantic Ridge were studied by X-ray diffraction and petrographic microscopy. Coarse fractions recovered as insoluble residues of foraminiferal sands consist of rock and mineral fragments identifiable as coming from two major sources: an ultrabasic terrain and a "normal" basic

volcanic and metamorphic greenstone terrain. Extensive variability in mineralogy supports the conclusion that local sources do contribute to the sediments around the Ridge, mixing during transportation has been slight, and the study of coarse fractions of foraminiferal oozes is a useful way to chart heterogeneous rock terrains on the ocean floor.—*from* Authors' abstract

02855 **Sims, P. K.; Yardley, D. H.** Exploration for copper–nickel in northeastern Minnesota, *in* Mining Symposium, 28th Ann., and AIME, Minnesota Sec., 40th Ann. Mtg., Duluth, 1967: Minneapolis, Minn., Univ. Minnesota, School Mineral and Metall. Eng., p. 59–64, illus., 1967.

Copper and nickel sulfide deposits within the Precambrian Duluth Gabbro Complex crop out in an arcuate pattern on the highland west of Lake Superior. Current exploration data indicate that sulfides are widely disseminated in the lower part of the gabbro body and locally extend upward from the base for distances of at least a few hundred feet; copper exceeds nickel by a ratio of three to one. Principal exploration objectives are to delineate deposits within the zone of widespread mineralization that are of sufficient size and grade to be minable at present prices. Geology and geophysics, as well as core drilling, are utilized. The area favorable for occurrence of commercial deposits far exceeds that of known deposits and, if current exploration discloses minable deposits, it can be expected that others will be found; the area could become a leading producer.—ESL

Sioda, R. *See* Donnay, Gabrielle. 02638

02574 **Sirkin, Leslie A.** Late–Pleistocene palynology and chronology of western Long Island–eastern Staten Island, New York [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3995B–3996B, 1967.

Skermer, N. A. *See* Hillis, S. F. 02744

02694 **Skinner, Brian J.; White, Donald E.; Rose, Harry J.; Mays, Robert E.** Sulfides associated with the Salton Sea geothermal brine: Econ. Geology, v. 62, no. 3, p. 316–330, tables, 1967.

Highly saline brine has deposited siliceous scale containing 20 percent Cu and up to 6 percent Ag. Minerals identified by X-ray and optical methods include bornite, digenite, chalcopyrite, chalcocite (new dense polymorph), stromeyerite, and native silver. Core samples of the reservoir rocks contain sphalerite, pyrite, pyrrhotite, chalcopyrite, and galena. The activity of sulfur calculated from one pyrite–pyrrhotite pair at 325°C is similar to the activity calculable from the FeS composition of sphalerite using a projection of the data of Barton and Toulmin. Metals are eight times sulfur (modal) but solutions are saturated in sulfide components. Most likely source of the metals is the reservoir sediments.—WSW

02648 **Skinner, C.; Burnham, Charles W.** Hydroxyapatite: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 293–294, table, 1967.

The results of a detailed structural analysis of hydrothermally synthesized hydroxyapatite $Ca_5(PO_4)_3(OH)$ are presented using an automated single-crystal diffractometer. Space group is $P6_3/m$; cell dimensions $a=9.421\pm0.004$, $c=6.883\pm0.003$A.—MST

02799 **Smart, J. Samuel.** A comment on Horton's Law of Stream Numbers: Water Resources Research, v. 3, no. 3, p. 773–776, illus., table, 1967.

Horton's Law of Stream Numbers is shown to be internally inconsistent in the following sense: If there exists a large channel network of order S, with stream numbers that satisfy Horton's Law exactly, then the mean stream numbers for lower order networks contained in the large one will show definite deviations from Horton's Law. These mean stream numbers can be expressed by a recursive formula, which involves the probabilities p_{ij} that a stream of order i terminates in a stream of order $j>i$. Reasonable assumptions about the nature of the p_{ij} suggest that Horton curves (log N_k versus k) for the small order basins should be concave upwards, a result which is in general agreement with observation.—Author's abstract

Smith, Alan R. *See* Wollenberg, Harold A. 02437

02875 **Smith, Charles Culberson.** Foraminifera, paleoecology, and biostratigraphy of the Paleocene *Ostrea thirsae* Beds, Nanafalia Formation (Wilcox Group), west central Alabama [abs.]: Houston Geol. Soc. Bull., v. 10, no. 1, p. 19, 1967.

02619 **Smith, Charles Isaac.** Physical stratigraphy and facies analysis, Lower Cretaceous formations, northern Coahuila, Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3570B, 1967.

02999 **Smith, Merritt B.; Engler, Vivian L.; Lee, Della I.; Wayland, Russell G.** (compilers). Reported occurrences of selected minerals in the northern third of California (includes most metals and nonmetals; does not include petroleum and natural gas): U.S. Geol. Survey Mineral Inv. Resource Map MR-47, scale 1:500,000, separate text, 1967.

Symbols on the map show reported locations of mines, prospects, and occurrences of selected minerals; neither inactive mines nor the size or grade of the mineral occurrence are indicated. Multiple occurrences of the same mineral within a section are not differentiated from a single occurrence; symbols such as those for gold, silver, copper, lead, zinc, and tungsten may be combined to show several different minerals in the same locality. The following are excluded: petroleum, gas, oil shale, pumice, cinders, and common varieties of clay, sand, gravel, stone, and low-grade occurrences of some metals, especially manganese and copper. Occurrences of widespread nonmetals, such as limestone, diatomite, and gypsum, are not shown unless currently exploited on a large scale, containing large reserves, or of unique character.—MCM

Smith, Ned M. *See* West, Terry R. 02965

02620 **Smith, Peter Henderson.** The structure and petrology of the Basler-Eau Claire Granite Complex, District of Mackenzie, N.W.T., Canada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3570B-3571B, 1967.

Smith, Robert B. *See* Cook, Kenneth L. 03004

02831 **Smith, W. D. M.** Lifetime log finds oil through casing: Canadian Petroleum, v. 8, no. 8, p. 16-17, illus., 1967.

The Neutron Lifetime Log (NLL), which is now being widely used in western Canada, can find hydrocarbons through casing by determining the percentage of water in the rock pore space. It is used most commonly for: (1) monitoring oil-water interfaces in producing reservoirs, (2) examining flooded-out wells for by-passed oil, (3) selecting intervals for recompletion, and (4) evaluating previously untested zones where the open-hole logs were undiagnostic. Case histories for the Leduc gas-water interface, the Halfway sandstone oil zone, and the Blairmore oil and gas zones are reported. The NLL is used to measure the formation capture cross-section for neutrons. This value (Σ) which is a function of the amount of chlorine present, can be used to find Sw in cased holes.—LLP

Smylie, D. E. *See* Mansinha, L. 02447

02804 **Soen, Oen Ing; Pauly, Hans.** A sulphide paragenesis with pyrrhotite and marcasite in the siderite-cryolite ore of Ivigtut, South Greenland: Medd. om Grønland, v. 175, no. 5, 55 p., illus., table, 1967.

The pyrrhotite-marcasite nodules occurring in coarse-grained siderite in siderite-cryolite ore may be considered crystallization products of fluids trapped in the siderite, and characterized by high CO_2 and S_2 pressures. Five phases are recognized in mineral formation from the system Fe-O-S-C. Crystallization occurred during cooling of the system from over 500°C to 200°C under decreasing pressures. Decrease in CO_2 pressures caused the stability fields of the iron sulfides to encroach on that of siderite. The concentric zonation of sulfides is explained by the $f_{sulfide}$-isogrades shifting with time around the core of the nodules. The absence of Fe-sulfides in the main sulfide paragenesis of the ore indicates that the S_2 pressures

were always too low for their formation during this crystallization from differentiated fluids.—*from* Authors' conclusions

02506 **Soga, Naohiro.** Elastic constants of garnet under pressure and temperature: Jour. Geophys. Research, v. 72, no. 16, p. 4227–4234, tables, 1967.

The elastic constants and their pressure and temperature derivatives for a single crystal of garnet (almandite–pyrope type, M/p = 23.9 where M = molecular weight and p = number of atoms in the molecule) have been determined by a pulse superposition method. At 25°C the adiabatic bulk modulus $B_S = 1{,}770$ kb; $(\delta B_S/\delta P)_T = 5.43$ and $(\delta B_S/\delta T)_P = -0.201$ kb deg. This value of $(\delta B_S/\delta P)_T$ is higher than for MgO, which has a similar bulk modulus but M/p = 20. Increase in M/p from 20 to 24 or high FeO content does not seem to affect the critical temperature gradient.—DBV

Somerton, Wilbur H. *See* Wilhelmi, Bernhard. 02838

02441 **Sommerfeld, R. A.** Quartz solution reaction, 400°–500°C, 1,000 bars: Jour. Geophys. Research, v. 72, no. 16, p. 4253–4257, illus., tables, 1967.

It is postulated that the solution species in quartz–water solutions at 1 kb changes between 400° and 500°C. This theory is tested by determining the molecularity of the solution reaction with respect to water by means of argon–water mixtures. The data indicate that a single solution reaction involving between 15 and 25 water molecules predominates at 400°C, whereas more than one reaction is important at 500°C.—Author's abstract

02893 **Sommerfeld, R. A.** A critical evaluation of the heats of formation of zoisite, muscovite, anorthite, and orthoclase: Jour. Geology, v. 75, no. 4, p. 477–487, tables, 1967.

Heats of solution ($-\Delta H$) of zoisite, 253.0±0.9 kcal GFW; muscovite, 214.8±1.3; and anorthite, 172.01±0.7, were measured by acid solution calorimetry, and corrected for impurities by a new method that assumes a perfect oxygen structure. Also, heats of formation of muscovite, anorthite, and orthoclase given by other workers are recorrected. Univariant curves are calculated for the reactions: 1) muscovite = orthoclase + corundum + vapor; 2) muscovite + quartz = orthoclase + sillimanite + vapor; and 3) 2 zoisite + sillimanite + quartz = 4 anorthite + vapor.—DRM

02784 **Sopper, William E.; Lull, Howard W.** (editors). Forest hydrology—Natl. Sci. Found. Advanced Sci. Seminar, University Park, Pa., 1965, Proc.: London and New York, Pergamon Press, 813 p., illus., tables, 1967.

It has long been recognized that forests and water are related, and the growing need for these resources has lent importance to their relationship. Forest watershed research has shown that water yield and water quality are measurably influenced by forest cutting practices. This two-week symposium was organized so that scientists in the field of forest hydrology might determine our present state of knowledge, current research needs and trends, and anticipated future research. From 22 countries 88 scientists participated; six of the papers are cited individually.—GDC

Spence, R. D. *See* Weijts, A. G. L. M. 02538

02621 **Spencer, Alexander Burke.** Alkalic igneous rocks of Uvalde County, Texas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3571B, 1967.

02866 **Spreng, A. C.** Slump features, Fayetteville Formation, northwestern Arkansas: Jour. Sed. Petrology, v. 37, no. 3, p. 804–817, illus., table, 1967.

At a single outcrop of the Fayetteville Formation (Upper Mississippian) in northern Arkansas, a small portion of the section of thin limestones and shales has slid or slumped to form rolls and recumbent folds as well as other features. Units of limestone and shale as much as five feet thick slid in a semiplastic condition. Chert bands in the limestone evidently had formed but not solidified before sliding.—HAT

02964 **Stallard, Alvis H.** Inventory of construction materials by photo interpretation in Kansas, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 7–9, 1967.

The Kansas highway construction program extends over hundreds of miles; different types of material are available in different regions and projects are designed to utilize local materials where possible. Aerial photographic interpretation provides an economical and expedient aid in their investigation, but a knowledge of the geology of the area is necessary to determine thickness uniformity of the source units and previously obtained quality data along with lithological characteristics. The system does not eliminate field investigations, but does eliminate certain areas that are not potential sources. Sampling and testing of the material must be performed to fulfill specification requirements and to obtain more detailed information on quality and quantity of material available.—GDC

Stanley, Rolfe S. *See* Hansen, Edward. 02715

02972 **Stearns, Ronald T.; Rambo, John T.** Project Pre-Gondola I, preshot geophysical measurements: U.S. Army Engineer Nuclear Cratering Group, Livermore, Calif., Rept. PNE 1111, 58 p., illus., tables, 1967.

A series of downhole measurements was performed at three out of four locations on a site near Glasgow, Mont. These measurements in nearly homogeneous [Bearpaw] Shale included density, gamma ray-neutron, caliper, electric, three dimensional velocity, continuous velocity, and seismic uphole-downhole logging; all except gamma ray-neutron and electric logging yielded useful quantitative data. Average densities ranged from 2.11 to 2.42 gm/cm^3, and average velocities fluctuated between 1,732 and 2,014 m/sec below the weathered zone. Density measurements by two groups compared favorably. *In situ* sonic velocities made by three different tools in the same hole showed a variation in measured value with the method used, suggesting that the distance between wave source and detector is responsible for the variation in measured velocity.—*from* Authors' abstract

02632 **Stemprok, M.** The Bi-Mo-S system: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 336–337, illus., 1967.

A study of phase relations in the Bi-Mo-S system was undertaken in an effort to gain knowledge of the conditions existing during the formation of the tin, tungsten, molybdenum type of ores. Because of slow reaction rates at low temperatures the initial experiments were performed at 1200°C.—MST

Stephens, J. W. *See* Albin, Donald R. 02827

02762 **Stermac, A. G.; Lo, K. Y.; Barsvary, A. K.** The performance of an embankment on a deep deposit of varved clay, *in* Papers presented at the 19th Canadian Soil Mechanics Conference, Pt. 1: Canadian Geotech. Jour., v. 4, no. 1, p. 45–61, illus.; reply to discussion, p. 66–67, 1967.

The soils investigation, instrumentation, and performance of embankments for approaches to an overpass on Highway 11 in the New Liskeard area in northern Ontario, founded on a thick deposit of varved clay, are described. Stage construction was chosen, with an 18 ft high fill as the first stage. At the end of a year, settlement was still at five inches per year. Nine feet of fill were removed; accounts are given of subsequent pore pressure and settlement behavior, as well as that prior to removal. These results require further study but it can be seen that important horizontal variation of strength may occur in an apparently uniform soil deposit.—ESL

Stevens, Rollin E. *See* Jackson, Everett D. 02465

Stewart, S. W. *See* Carder, Dean S. 02997

02782 **Stoneley, R.** The structural development of the Gulf of Alaska sedimentary province in southern Alaska [abs.]: Geol. Soc. London Proc. 1965–66, no. 1635, p. 178; discussions, p. 178–181, 1967.

02534 **Strangway, D. W.** Field tests for stability, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 209–216, illus., 1967.

There are many tests which can be applied to the study of magnetic stability in rocks. Most of these are based on laboratory experiments but these tests cannot adequately study the effects of long geological time. Whenever possible it is, therefore, useful to conduct field experiments in which nature has given us data which we can interpret as proofs of stability.—Author's summary

02862 **Street, Norman.** The axial ratio of clays: Jour. Sed. Petrology, v. 37, no. 3, p. 956–957, 1967.

The axial ratio of clay particles is estimated by a combination of gas-adsorption determination of surface area and a calculated surface area from particle-size distribution.—HAT

02516 **Strick, E.** The determination of Q, dynamic viscosity and transient creep curves from wave propagation measurements, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 197–218, illus., 1967.

The best theoretical approximation to observed attenuation and propagation of seismic body waves is that of Futterman (1962). However, his assumption of a linear attenuation-frequency relation requires truncation at both ends of the frequency spectrum which leads to unnecessary parameters that make his approximation awkward to use. A power-law approximation to the attenuation characteristic is discussed here which does not have this difficulty. Emphasis is on computation of mechanical properties such as spatial Q, magnitude and loss angle of the modulus, dynamic viscosity, and transient creep. These computations, based on Jordan's wave propagation measurements (1966), are in remarkable agreement with independent measurements by Lethersich (1950).—DBV

Striffler, W. David. *See* May, Robert F. 02790

Suhr, N. H. *See* Ingamells, C. O. 02494

Sullivan, John C. *See* Barger, R. M. 02937

02926 **Sullwold, Harold H., Jr.** A second defense of rational stratigraphic nomenclature (a critique of Sacramento Valley Correlation Sections 15 and 16 [1967]): Pacific Petroleum Geologist, v. 21, nos. 8–9, p. 2–3, 1967.

Sullwold commends the American Association of Petroleum Geologists Pacific Coast Section for their presentation of the physical correlations of the Sacramento Valley area, but regrets that the committee did not follow the Code of Stratigraphic Nomenclature to the degree necessary to establish formal names. Some examples are cited and the suggestion is made that indications on the sections of the intervals in wells in which diagnostic fossils were found would help evaluate the validity of the biostratigraphic terminology. The problem of rock-stratigraphic nomenclature could be resolved in part by use of members when subdivisions of well-known formations are involved, and by arbitrary committee decisions on geographic boundaries of shale units when their lateral extent becomes obscure owing to disappearance of an overlying or underlying sand body.—MCM

02544 **Surdam, Ronald Clarence.** Low-grade metamorphism of the Karmutsen Group, Buttle Lake area, Vancouver Island, B. C. [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 11, p. 3996B, 1967.

Syono, Yasuhiko. *See* Ahrens, Thomas J. 02427

02584 **Szabo, B. J.** Radium content in plankton and sea water in the Bahamas: Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1321–1331, illus., tables, 1967.

The distribution of Ra-226 in the ocean and marine organisms is surveyed. Data on the distribution of Ra in the Bahamas region are presented; average Ra content in surface water is 4.5×10^{-14} g per l. The average Ra content in plankton is $2.2\text{-}10^{-13}$ g per g_{ash}. Discrimination factors are calculated. Both Ra and Ba are preferred by the plankton, there is little preference for Sr, and Mg is not taken up preferably. The extent of Ra removal by the plankton populations is calculated to be of the same order of magnitude as the natural radioactive decay of Ra.—DBV

02724 **Tabor, Rowland W.** Geologic map of the Williamsburg quadrangle, Whitley County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-616, scale 1:24,000, section, text, 1967.

Mineral resources currently exploited in the Williamsburg quadrangle are coal, oil, and gas. Principal coal beds are the Big Mary(?), 30–40 inches thick where mined and prospected; Jellico, 30–40 inches thick; Blue Gem, 24–30 inches thick; Little Blue Gem, 8–12 inches thick; and River Gem, 18–24 inches thick where stripped. Thickness and extent of beds in the southwestern section on Jellico Mountain are unknown. Limited amounts of oil are produced from the Rockcastle Sandstone Member of the Pennsylvanian Lee Formation, and gas for local use from the Mississippian Newman Limestone. Clay shale from 30 feet above the River Gem coal bed has been tested for use as lightweight aggregate with excellent results; slabs of thin-bedded sandstone under the bed have been used locally.—MCM

02475 **Tagg, A. Richard; Uchupi, Elazar.** Subsurface morphology of Long Island Sound, Block Island Sound, Rhode Island Sound, and Buzzards Bay, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C92-C96, illus., 1967.

Continuous seismic profiles from Long Island Sound, Block Island Sound, Rhode Island Sound, and Buzzards Bay show a widespread reflector ranging in depth from 16 to 200 m below sea level or 0 to 160 m beneath the bottom. This reflector delineates the top of the pre-Cretaceous rocks. Relief of the reflector appears to be due mainly to fluvial erosion modified by glacial erosion.—Authors' abstract

Tailleur, Irvin L. *See* Donnell, John R. 02704

03009 **Takin, M.; Talwani, M.** Rapid computation of the gravitational attraction of topography on a spherical Earth [abs.], *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1-3, p. 373, 1967.

Talwani, M. *See* Takin, M. 03009

Taylor, Ira D. *See* Dobervich, George. 03032

Taylor, J. H. *See* Davidson, C. F. 02903

02854 **Teleki, P. G.** Automatic analysis of tracer sand: Jour. Sed. Petrology, v. 37, no. 3, p. 749-759, illus., 1967.

The recently developed Automatic Fluorescent Particle counter eliminates the inability of sample analyses to keep in step with experimental work in quantitative sediment transport research. The instrument counts the grains and at the same time detects and counts separately as many as four different tracer colors in a one-particle-thick stream of grains falling past its optical system.—RAC

Textoris, Daniel A. *See* Carozzi, Albert V. 02967

02934 **Thalman, A. L.** Geology of the Oakdale Red Fork sand field, Woods County, Oklahoma: Shale Shaker, v. 18, no. 1, p. 3-11, illus., 1967.

The Oakdale field is in southeastern Woods County on the northeastern flank of the Anadarko Basin. Following major pre-Mississippian uplift and erosion, the sequence of events in the area may have been: gradual subsidence and transgression of early Pennsylvanian seas, regression and development of marshy tidal flat,

development of erosional channels, deposition of lower Red Fork sand in the channels and of upper Red Fork as a delta plain or flood plain, and continued deposition and compaction. Primary recoverable oil is estimated at 120 bbl/acre-ft, and gas reserves on a volumetric basis at 540 MCF/acre-ft. Since a large area of northwestern Oklahoma contains a favorable environment for Red Fork sand deposition, it should merit diligent exploration effort.—LLP

02742 **Thomas, William L., Jr.** The Pacific Basin—An introduction,*in* The Pacific Basin—A history of its geographical exploration (edited by Herman R. Friis): Am. Geog. Soc. Spec. Pub. 38, p. 1–17, illus., 1967.

The Pacific Basin is described with emphasis on the physical differences in location, size, origin, composition, and shapes of the major landform features. The topics discussed are: (1) arrangement of the land—Pacific rim, empty areas, and island arcs, clusters, and isolates; (2) island origins and sizes—the "andesite line," volcanoes and earthquakes, ocean floor, calcareous reefs, Pleistocene heritage, and island types; (3) island landforms—"high" islands (continental and volcanic), "low" islands (elevated and sea-level reefs), and the atoll environment; (4) climatic regionalization; and (5) habitats for man.—LLP

02996 **Thompson, M. C.; James, H. B.** Correction of atmospheric errors in electronic measurements of Earth crust movements: Seismol. Soc. America Bull., v. 57, no. 4, p. 641–655, illus., 1967.

Three methods are described for correcting electronic measurements of earth movement for atmospheric refraction effects. The effectiveness of two of these is discussed in terms of experimental studies using microwave systems. Precision of the order of 1 part in 10^9 (1 micron in 1 km) appears to be attainable.—Authors' abstract

Thornbury, William D. *See* Powell, Richard L. 02797

Thorpe, A. *See* Donnay, Gabrielle. 02638

Thorpe, A. *See* Donnay, Gabrielle. 02650

02741 **Thrailkill, John V.** Geology of the Rio Camuy Cave area, Puerto Rico: Natl. Speleol. Soc. Bull., v. 29, no. 2, p. 35–37, illus., 1967.

In northwestern Puerto Rico, tropical karst is well developed and cone-shaped hills are common. The exposed rock in the area has been assigned (Zapp, 1948) to the middle Oligocene Rio Guatemala Group which comprises sands and gravels of the San Sebastian Formation, massive reef limestones of the Lares Limestone, and soft, chalky limestones of the Cibao Formation. Karst in the cave area is divided into three categories: (1) tower karst—occurs in belts north and south of the cave area and contains distinctive truncated cones, (2) kegelkarst—occurs in two belts within the borders of the tower karst, and is composed of small residual hills, and (3) doline karst—occupies an east-west belt about 4 km wide, and contains all explored portions of the Rio Camuy Cave.—LLP

03018 **Thralls, Hugh M.** Geophysical evidence of untapped or insufficiently explored parts of the stratigraphic section [abs.]: Shale Shaker, v. 18, no. 1, p. 13, 1967.

02629 **Tilley, C. E.; Yoder, H. S., Jr.; Schairer, J. F.** Melting relations of volcanic rock series: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 260–269, illus., tables, 1967.

The authors report the results of some experiments on the melting relations of tholeiitic and alkalic volcanic rock series. Studies have been made of a potassium-enriched suite with members ranging from basalts to end-stage trachytes, the volcanic group of the Gough Island in the South Atlantic. Studies on the Hebridean alkali series have been extended to cover the rarer intermediate and trachytic members, to provide a clearer picture of differentiation of this series. A beginning has been made of the study of extreme members of the recent lava sequence of Parícutin, Mexico, which is petrographically and chemically well-investigated.

Further experiments on the tholeiitic series of Kilauea have been conducted also.—MST

Tilley, C. E. *See* Schairer, J. F. 02714

Tirey, G. B. *See* Miller, H. J. 02977

Tocher, Don. *See* Carder, Dean S. 02997

02503 **Toksöz, M. Nafi; Chinnery, Michael A.; Anderson, Don L.** Inhomogeneities in the Earth's mantle, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 31–59, illus., table, 1967.

The velocity structure of the mantle is determined with emphasis on regions of anomalous variations (so-called "discontinuities"). Shear velocity profiles with discontinuities at 350 and 700 km and a low-velocity zone extending to 350 km are found for the upper mantle, and P-velocity profiles with discontinuities at 700, 1,200, and 1,900 km for the lower mantle. Investigation of lateral variations shows lower velocities in the upper mantle under oceans, highest velocities in shields. These differences are attributed to temperature variations. An investigation of geoid undulations to determine the sources of the anomalies leads to the conclusion that the main sources of lateral density variations must be in the mantle at depths greater than about 100 km.—DBV

02671 **Tolansky, S.; Komatsu, H.** Abundance of type II diamonds: Science, v. 157, no. 3793, p. 1173–1175, illus., 1967.

More than 1,300 natural microdiamonds, mostly averaging 0.0015 carat, were studied for transparency to ultraviolet radiation. Of most of them, of this size, 16 percent were completely transparent (presumably type II); 27 percent, completely absorbent (presumably type I). The remainder transmitted partially. The number of type-II diamonds is unexpectedly very high; a considerable proportion of microdiamonds may begin life as type II, later incorporating absorbent type-I material.—*from* Authors' abstract

03001 **Toler, L. G.** Fluoride in water in the Alafia and Peace River basins, Florida: Florida Geol. Survey Rept. Inv. 46, 46 p., illus., tables, 1967.

Waste water from phosphate chemical plants in the tributary headwater areas contributes fluoride and other waste products to the Alafia and Peace Rivers. Analysis reveals that much more waste water is released to streams during periods of high discharge than periods of low discharge. Fluoride in waste water has apparently not entered in sufficient quantity to cause widespread increases in concentration of fluoride in ground water; the highest is in water from the Hawthorn and Tampa Formations of Miocene age. The fluoride apparently dissolves from the fluoride-bearing phosphatic minerals in the rocks. The areal approach used in this investigation did not resolve whether contamination of ground water by fluoride occurs locally; the greatest potential hazard appears to be the chemical plant settling lagoons.—*from* Author's abstract

02747 **Tomikel, John C.; Shepps, Vincent C.** The geography and geology of Erie County, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Inf. Circ. 56, 64 p., illus., tables, 1967.

Erie County is in the Central Lowland and Appalachian Plateau. The lake plain is very flat except for former beaches; a cliff along the lake exposes glacial drift and some bedrock. An escarpment slope leads to the upland plateau which has an incised drainage network, and a drumlin field near Waterford. Beds of Precambrian to Pennsylvanian age underlie the county, with the thickest sequence in the south; stratigraphy of outcropping Devonian–Pennsylvanian beds is reviewed. The first three stages of Pleistocene glaciation probably crossed Erie County, but deposits are buried. Four advances of Wisconsin glaciation are described and a map shows deposits. Effects of glaciation on drainage, and formation of lakes, bogs, and swamps are discussed. Ground water is obtained mostly from glacial

deposits, especially valley fills. Resources include oil and gas, construction materials, peat, clay, and brines.—ESL

Tourtelot, Harry A. *See* Donnell, John R. 02704

02589 **Trainer, Frank W.** Measurement of the abundance of fracture traces on aerial photographs, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575–C, p. C184–C188, illus., 1967.

This study [near Front Royal, Va.] illustrates an objective method of investigating the areal abundance of fracture traces seen on aerial photographs. A uniform duration of search, in time per unit area, assures consistent results. The rate of discovery of the traces decreases logarithmically with time. The probable total number of traces per unit area can be estimated from the straightest part of the discovery–time curve, or the number of traces found in a relatively short search can be used as an index of abundance. Contour maps prepared from such index numbers illustrate the areal distribution of abundance. The abundance of the traces and that of their intersections are potentially useful as indices of the near-surface fracture porosity of the rock.—*from* Author's abstract

02815 **Tremaine, Marie.** (editor). Arctic bibliography, V. 13: Montreal, Quebec, Arctic Inst. North America, 1554 p., illus., 1967.

Volume 13 is one of a series of volumes prepared since 1947 by the Arctic Institute of North America which systematizes, abstracts, and indexes scientific literature on the arctic and subarctic regions of the world. This volume contains 8,011 abstracts in English of publications appearing originally in Russian, English, Scandinavian, German, French, and other languages; 88.5 percent of the volume represents publications of 1960–1963. The scope of the abstracted papers includes geophysical phenomena, new discoveries, cosmophysical theories, solar radiation studies, effects of stream diversion, and mineral exploration and development.—LLP

Trettin, H. P. *See* Agterberg, F. P. 02832

02890 **Tuthill, L. H.; Adams, R. F.** Importance of petrographic analysis and special tests not usually required in judging quality of concrete sand—Discussion [of paper by R. E. Davis, R. C. Mielenz, and M. Polivka, 1967]: Jour. Materials, v. 2, no. 3, p. 480–482, 1967.

The great amount of time required for tests on strength, shrinkage and durability make them practical only when a very thorough investigation of sands can be made prior to use. Three others—petrographic analysis, attrition test, and rate of slump loss—can be accomplished in a day. The attrition test deserves consideration for inclusion with suitable criteria in ASTM Specifications C33. Decrease in fineness modulus and particularly the percent passing the No. 200-mesh sieve are the values indicative of performance and quality. After attrition tests, different California sands, six percent reduced by passing this sieve, have shown good concrete-making properties, compared with Davis and others' (ibid., p. 461–486) poor sand which passed 18 percent. Caution is advised with sands reduced by more than 8 or 9 percent.—GDC

Uchupi, Elazar. *See* Tagg, A. Richard. 02475

02787 **Urie, Dean H.** Influence of forest cover on ground-water recharge, *in* Forest hydrology—Natl. Sci. Found. Advanced Sci. Seminar, University Park, Pa., 1965, Proc.: London and New York, Pergamon Press, p. 313–324, illus., 1967.

Methods are presented for determining the net water yield of forest lands in coarse-textured glacial drift by analysis of changes in ground-water storage. These changes due to seepage flow, evapotranspiration, and recharge from percolating precipitation are separated by graphical interpretation of recording-well records. Comparisons of three forest cover conditions in northwestern Lower Michigan showed that over a period of two years the net annual water yield of deciduous forests exceeded the yield under pine plantations by an average of 2.6 in.; it exceeded that of mixed pine-oak stands by 3.0 in. These differences were associated with deeper snow packs

in the deciduous forests and longer evapotranspiration periods in pine than in hardwoods.—*from* Author's abstract

02598 **U.S. Geological Survey.** Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C1-C251, illus., tables, 1967.

This collection contains 44 papers on mineralogy and petrology, structural geology, marine geology, geochemistry, paleontology and stratigraphy, analytical techniques and instrumentation, glacial geology and glaciology, economic geology, engineering geology, volcanology, geomorphology, photointerpretation, ground water, surface water, quality of water, limnology, and hydrologic instrumentation. All but some of the surface water papers are cited separately.—MCM

02510 **U.S. Library of Congress.** Bibliography on snow,ice and frozen ground, with abstracts, V. 21: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. CRREL Rept. 12 (v. 21), 290 p., 1967.

This volume, one of a series of volumes published since 1951, provides a comprehensive bibliography of current basic and applied scientific research on snow, ice, and frozen ground, and information about living and working in polar regions and other cold areas. Each entry includes a bibliographic citation, code designating the library holding of the abstracted item, assigned call number, Universal Decimal Classification number, and an abstract.—LLP

02840 **vanAndel, Tjeerd H.; Corliss, John B.; Bowen, Vaughan T.** The intersection between the Mid-Atlantic Ridge and the Vema Fracture zone in the North Atlantic: Jour. Marine Research, v. 25, no. 3, p. 343-351, illus., 1967.

Near 11° N., the Mid-Atlantic Ridge is offset by the Vema Fracture. First motion studies of recent earthquakes along the fracture indicate that it is a transform fault; the fault zone is developed as a deep, narrow, east-west trending trough, bordered on the south by a high rocky wall representing an uplifted slice of crust. More than 1 km of evenly and horizontally bedded sediments fill the trough, indicating stability and considerable age. Several similar valleys that occur south of the fracture appear to be seismically inactive. Thus the young and active Mid-Atlantic Ridge is offset by a system of much older and possibly long-inactive fractures, suggesting that sea-floor spreading in this area has begun recently. The tectonics of the southern wall are not understood; discontinuities in the mantle may account for its presence.—*from* Authors' abstract

02421 **Vangengeim, E. A.** The effect of the Bering Land Bridge on the Quaternary mammalian faunas of Siberia and North America, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 281-287, 1967.

Analysis of fossil faunas from the Anthropogene of eastern Siberia indicates a possible connection between continents during Villafranchian, when migration of animals most probably took place. A close similarity between faunas of eastern Siberia and North America existed from the beginning of Illinoian until the end of late Wisconsin time. There could have been interruptions in the connection, as indicated by transgressive marine sediments in the extreme northeastern part of Asia, but they need not have been lengthy, because neither in Asia nor in Alaska did substantially different mammals evolve. A detailed study of Quaternary deposits, fauna, and flora of eastern Siberia, and preparation of detailed paleogeographic and vegetation maps for stages of the Anthropogene will be helpful in enlarging and correcting these historical interpretations.—*from* Author's abstract

VanHorn, Richard. *See* Sheridan, Douglas M. 02768

02511 **Vesper, William H.** Behavior of beach fill and borrow area at Sherwood Island State Park, Westport, Connecticut: U.S. Army Corps Engineers Coastal Eng. Research Center Tech. Memo. 20, 25 p., illus., tables, 1967.

In 1957, to restore and stabilize the beach of Sherwood Island State Park, sand was pumped to the shore from an offshore borrow area and two training walls were constructed to confine the inlet at the east end (updrift) and a groin was built

at the west end of the park. The beach was widened and raised and an extra amount of sand was placed on Sherwood Point to act as a feeder. In 1962, surveys showed that actual net loss of sand from the area was slight, but losses from the tidal zone in the updrift and central parts of the area were major. These losses indicate that maintenance fill is now required and construction of several short groins west of Sherwood Point may be desirable. Graphs show comparative profiles of the area, changes in shoreline, and composite size-distribution curves for sand samples. Tables show volume changes and sand sample data.—*from* Author's abstract

Vestine, E. H. *See* Kahle, Anne B. 02991

02992 **Vestine, E. H.; Ball, R. H.; Kahle, Anne B.** Nature of surface flow in the Earth's central core: Jour. Geophys. Research, v. 72, no. 19, p. 4927–4936, illus., tables, 1967.

The contribution to secular change made by the nonuniform velocity of the fluid at the surface of the Earth's core in the presence of the Earth's main field is discussed. It is shown that contributions to secular change made by temporal changes in the flow pattern of the fluid may be important. Results are discussed qualitatively in relation to dynamo theories of the Earth's main field. It is also shown that surface fluid motions that can very nearly reproduce secular change also show features compatible with the generator models of Bullard, Herzenberg, Parker, and Tverskoy. The degree of compatibility found does not allow a preferred choice among these various generators.—Authors' abstract

Vickery, Robert K., Jr. *See* Lindsay, Delbert W. 02990

02794 **Vogt, Peter R.; Ostenso, Ned A.** Steady state crustal spreading: Nature, v. 215, no. 5103, p. 810–817, illus., 1967.

The assumption that the mid-ocean rises represent a steady state leads to estimates of the rate of ocean spreading and of subsidence which in turn suggest geophysical tests of the theory.—DBV

Volk, Richard W. *See* Clair, Joseph R. 03031

02930 **Volpe, E. Peter.** Understanding evolution: Dubuque, Iowa, Wm. C. Brown Co. Publishers, 160 p., illus., tables, 1967.

This account of the evolutionary process is presented for the college student seeking a liberal education. Modern observations and experiments and examples of changes in human populations are used to illustrate the evolutionary process. The 14 chapters are: meaning of evolution, origin of genetic variation, genetic equilibrium, concept of selection, selection in action, balanced polymorphism, nonadaptive evolution, races and species, cataclysmic evolution, adaptive radiation, major adaptive radiations, convergence, origin and history of life, and emergence of man.—LLP

02599 **VonGonten, William Douglas.** Correlation of physical properties of porous media [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3547B, 1967.

02578 **Wadsworth, William Bingham.** Quantitative petrology of epizonal and mesozonal-catazonal granitic plutons (A preliminary comparison of two plutons with special reference to areal variation in textural properties) [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3571B–3572B, 1967.

02847 **Wagener, H. D.** Potential sources of granite for monumental stone in southwestern Fairfield County, South Carolina: South Carolina Div. Geology Geol. Notes, v. 10, no. 4, p. 51–56, illus., 1967.

Southwestern Fairfield County has considerable potential as a major source area for monumental granite of various colors, shades, and grain sizes. The Winnsboro Blue Granite is just one such variety, and is a very small body of homogeneous granite relative to the sizes of other homogeneous granite bodies in the Winnsboro complex.—Author's conclusions

02622 **Wagner, William Philip.** Correlation of Rocky Mountain and Laurentide glacial chronologies in southwestern Alberta, Canada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3572B, 1967.

Waldbaum, David R. *See* Klein, Cornelis, Jr. 02891

02778 **Walker, G. P. L.** Photographs of volcanoes near Mexico City and in Guatemala [abs.]: Geol. Soc. London Proc. 1965–66, no. 1632, p. 94, 1967.

02740 **Walker, George W.; Peterson, Norman V.; Greene, Robert C.** Reconnaissance geologic map of the east half of the Crescent quadrangle, Lake, Deschutes, and Crook Counties, Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-493, scale 1:250,000, section, 1967.

02756 **Walker, Loyd E.** Occurrence and quality of ground water in Coleman County, Texas: Texas Water Devel. Board Rept. 57, 103 p., illus., tables, 1967.

In Coleman County, in north-central Texas, ground water of usable quality occurs in limited amounts in Ordovician, Pennsylvanian, Permian, and Cretaceous sediments, and in alluvial deposits in stream valleys. The Cretaceous Trinity Group supplies about 45 percent, the Permian Wichita and Clear Fork Groups about 40 percent, the remaining 15 percent being from the Pennsylvanian Canyon and Cisco Groups, surficial alluvium, and the Ordovician Ellenburger Group. Principal chemical constituents affecting quality are calcium, sodium, bicarbonate, chloride, and sulfate; range in quality is variable. Methods of disposal of oil-field brine account for impairment of soils and native-quality water in some areas.—*from* Author's abstract

02492 **Walker, Theodore R.** Color of Recent sediments in tropical Mexico—A contribution to the origin of red beds: Geol. Soc. America Bull., v. 78, no. 7, p. 917–919, illus., 1967.

The color of Recent fluvial sediments in tropical Mexico supports the hypothesis that the hematite pigment in ancient red beds forms in situ after deposition and is not derived from erosion of red tropical (lateritic) soils, as is commonly claimed. Although red soils do occur in the region's hot humid source areas, the Recent alluvium that is transported and deposited by rivers is grayish brown because the red detritus is masked by more abundant nonred material. Red coloration occurs only in soils resulting from prolonged weathering on well-drained upland surfaces of Pleistocene age or older.—Author's abstract

02623 **Warme, John Edward.** Paleoecological aspects of the recent ecology of Mugu Lagoon, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3572B–3573B, 1967.

Warner, Jeffrey. *See* Hussey, Arthur M. 02918

Wayland, Russell G. *See* Smith, Merritt B. 02999

Wayne, William J. *See* Schneider, Allan F. 02880

02773 **Weaver, Charles E.** The significance of clay minerals in sediments, Chap. 2 *in* Fundamental aspects of petroleum geochemistry (B. Nagy and U. Colombo, editors): Amsterdam and New York, Elsevier Publishing Co., p. 37–75, illus., tables, 1967.

This chapter covers briefly the structure and composition of the major clay mineral types, distribution and occurrence of clay minerals in sedimentary rocks, and value of clays to the field of petroleum geology and geochemistry. The relative distribution of the four major clay-mineral groups through the geologic periods is summarized; their content in relation to Recent environments is similar to that in ancient shales. Shales comprise over 50 percent of sedimentary rocks and contain three-fourths of the preserved organic matter. At deposition they probably contained over three-fourths of the water trapped in sediments; their compaction causes most of the fluid migration. Most sandstone and some limestone reservoirs contain clay minerals which affect emplacement and withdrawal of hydrocarbons.—GDC

02859 **Weaver, Charles E.** Variability of a river clay suite: Jour. Sed. Petrology, v. 37, no. 3, p. 971–974, illus., 1967.

The variability of the clay suites of suspended samples collected from the Arkansas River over a two-year period is determined by storm patterns.—HAT

02675 **Weaver, Kenneth F.** Magnetic clues help date the past: Natl. Geog. Mag., v. 131, no. 5, p. 696–701, illus., 1967.

Archeomagnetic methods have been used to date the pre-Columbian Snaketown ruins in the Arizona desert, once occupied by the ancestors of the Hohokam Indians. The position of the magnetic pole at the time of Snaketown has been estimated from measurements of the remanent magnetism of clays from fire pits at the site; when compared with the map of polar wandering, the age of the site is calculated to be about 2,000 years old. This agrees well with the dates obtained by tree rings and radiocarbon methods.—VSN

Webb, William M. *See* Carr, Donald D. 02946

02968 **Weber, F. Harold, Jr.; Matthews, Robert A.** Prospecting for barite in northern Shasta County: California Div. Mines and Geology Mineral Inf. Service, v. 20, no. 9, p. 107–114, illus., 1967.

Barite in the Glidden Company deposit and vicinity in the Klamath Mts., 40 mi north of Redding, Calif., is interlayered with siltstone, and is restricted to an interval about 25–500 feet below discontinuous bodies of fetid, bluish-gray limestone, shown by fossils to be Devonian in age. The ore layer is usually 5–8 feet thick and almost pure barite. It probably formed by replacement of selected layers of mudstone, but the darkest may have replaced limestone, as it has a fetid odor. The barium may have been derived from limestone during diagenesis, or from ascending hydrothermal waters. The limestone bodies lie along an 11-mi trend, and barite has been found only along one mile, so it seems reasonable that there may be more. Suggested guides to prospecting based on the geology of the known deposits are given.—ESL

02727 **Weber, Jon N.; Deines, P.** Erroneous conversion of carbon isotope data—Comments on a paper by Cheney and Jensen (1965): Geochim. et Cosmochim. Acta, v. 31, no. 8, p. 1343–1344, 1967.

It is shown that the correction made by Cheney and Jensen (ibid., v. 29, no. 12, p. 1331–1346, 1965) to the carbon isotopic data of Thode and others was unnecessary. However, retention of the original data does not alter the conclusion that salt dome calcites are isotopically and geologically different from those of the Sicilian sulfur limestones and the Gas Hills calcites.—DBV

02514 **Weichert, D. H.; Manchee, E. B.; Whitham, K.** Digital experiments at twice real-time speed on the capabilities of the Yellowknife seismic array, *in* Internat. Symposium on Geophysical Theory and Computers, 3d, Cambridge, England, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 13, nos. 1–3, p. 277–295, illus., 1967.

A new method has been developed for reducing data from the Yellowknife experimental seismic array in Northwest Territories, Canada. The processing is now done at twice real time speed, and this may be increased. Using a unit weight delay and sum technique followed by cross correlation of signals in the two arms of the array, some impressive statistics on detection capability and signal-to-noise improvement have been obtained. The results so far suggest that a comparatively small number of well distributed and well sited medium aperture arrays working cooperatively could locate quickly essentially all earthquakes.—DBV

02538 **Weijts, A. G. L. M.; Poulis, J. A.; Spence, R. D.** The use of a commercially available fluxgate magnetometer in determination of the Curie point of rock samples, *in* Methods in palaeomagnetism—NATO Advanced Study Inst. on Palaeomagnetic Methods, Univ. Newcastle upon Tyne, 1964, Proc.: New York, American Elsevier Publishing Co., p. 447–449, illus., 1967.

By choosing the right oven and method of measurements, commercially available fluxgate magnetometers may provide a simple way of measuring Curie points with adequate accuracy.—Authors' summary

Weiser, Dan. *See* Kvenvolden, Keith A. 02496

02994 **Weismiller, R. A.; Ahlrichs, J. L.; White, J. L.** Infrared studies of hydroxy-aluminum interlayer material: Soil Sci. Soc. America Proc., v. 31, no. 4, p. 459-463, illus., 1967.

Differential infrared spectra of films of Al-montmorillonite matched with films of Al-montmorillonite with artificially introduced hydroxy-aluminum interlayers showed the interlayer to give absorption bands at 3,695 cm^{-1} and 3,570 cm^{-1} of nearly equal intensity. The pleochroism of the 3,695 cm^{-1} band indicated an orientation of many of the hydroxyls normal to the oxygen surface of the montmorillonite. The nonpleochroic nature of the 3,570 cm^{-1} band indicated an orientation at a moderate angle to the oxygen surface for the balance of the interlayer hydroxyls. Changes in frequency upon drying can be explained by dehydration and a closer association of the high frequency hydroxyls with the oxygen surface of the clay. An interlayer structure is proposed based on the frequencies, intensities, and pleochroism of the infrared absorption bands.—*from* Authors' abstract

Welch, N. H. *See* Allen, P. B. 02800

Wells, J. S. *See* Anderson, K. H. 03022

02683 **Wenk, H. R.; Baker, D. W.; Griggs, D. T.** X-ray fabric analysis of hot-worked and annealed flint: Science, v. 157, no. 3795, p. 1447-1449, illus., tables, 1967.

Two specimens of flint described by Green [ibid., p. 1444-1446] have been subjected to intensive X-ray fabric analysis. The specimen compressed in the β-quartz field recrystallized to a fabric with a strong maximum of c-axes parallel to the direction of compression and a weaker equatorial concentration perpendicular to the axis of compression. Annealing of a similar specimen eliminated the equatorial concentration and strengthened the axial concentration six- to eight-fold. In the latter specimen, the fabric determined by X-ray analysis agrees closely with Green's optically measured fabric. It is possible to obtain c-axis fabrics directly from the very weak 0003 diffraction peak.—Authors' abstract

Wertman, W. T. *See* Manger, G. Edward. 02591

03000 **Wesselman, J. B.** Ground-water resources of Jasper and Newton Counties, Texas: Texas Water Devel. Board Rept. 59, 167 p., illus., tables, 1967.

Geologic and hydrologic units yielding large quantities of fresh or slightly saline water to wells in Jasper and Newton Counties are the Tertiary Yegua Formation, Jackson Group, Catahoula Sandstone, and the Jasper, Evangeline, and Chicot aquifers. Average coefficients of permeability range from 260 to 1,232 gpd per sq ft. Water levels in all aquifers have been lowered to some extent; the greatest decline, about 200 feet, in the Evangeline aquifer in southwestern Jasper County has caused a local subsidence of the surface of from one to two feet. Chemical quality of most ground water is excellent with the exception of an "iron" problem which can be remedied. Recommendations are made for expansion of the ground-water observation program.—*from* Author's abstract

02965 **West, Terry R.; Smith, Ned M.; Johnson, Robert B.** The use of statistical analysis in quarry evaluation, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 10-25, illus., tables, 1967.

In laboratory tests, to evaluate quarry stone, questions often concern degree of mixing of rock units during blasting, loading, and hauling, and changes in aggregate quality during crushing and sizing. Using the Los Angeles abrasion test, a study was made of an Indiana quarry with three formation units—the Harrodsburg, Salem, and St. Louis Limestones—all class A stone. The change in abrasion value

corresponded with vertical change in lithology; that within a horizontal unit was insignificant as compared with the total variation. The percentage of Harrodsburg fragments in the samples was reduced significantly during processing. The abrasion loss value is less for in progress and stockpile samples than for ledge samples in the quarry.—GDC

Wharton, Heyward M. *See* Martin, James A. 02960

02786 **Whipkey, Ronald Z.** Theory and mechanics of subsurface stormflow, *in* Forest hydrology—Natl. Sci. Found. Advanced Sci. Seminar, University Park, Pa., 1965, Proc.: London and New York, Pergamon Press, p. 255–260, 1967.

Subsurface stormflow in general moves laterally through soil toward a stream channel, quickly without entering the ground water zone. Most studies of flow through porous media have been with homogeneous material under ideal conditions; few equations apply to forest soil. Reported here are plot experiments on soils ranging from a fine silt loam to a relatively coarse sandy loam, at depths up to six feet, on slopes of 19 to 42 percent. In coarse-textured soil, discharge seeped first from the deepest part, after build up of saturation; no intermediate discharge indicated predominantly vertical rather than horizontal inflow; outflow seepage rate was slow but uniform for about ten days, and was more characteristic of base flow. Most storm flow seeped in through root holes, cracks, and faunal openings. Among questions still to be answered is one dealing with possible deep seepage and ground-water recharge.—GDC

White, Donald E. *See* Skinner, Brian J. 02694

White, George W. *See* Goldthwait, Richard P. 02962

White, J. L. *See* Weismiller, R. A. 02994

White, S. *See* Donnay, Gabrielle. 02650

Whitham, K. *See* Weichert, D. H. 02514

02957 **Wilband, John T.; Kneller, William A.** Relationships between α-quartz cell parameters and some physio-chemical properties of chert aggregates, *in* A symposium on industrial mineral exploration and development—Forum on Geology of Industrial Minerals, 3d, Univ. Kansas, 1967, Proc.: Kansas Geol. Survey Spec. Distrib. Pub. 34, p. 111–119, tables, 1967.

Cell parameters of 22 chemically analyzed chert samples were determined by least squares computer analysis of X-ray powder photographs before and after double heating to 1,000°C. In most pairs both lattice parameters a and c increased, with the largest increase in a. This increase of a in heated samples correlated with deleterious behavior of unheated chert in high alkali cement. A less pronounced correlation is apparent between expansion of heated samples and two properties of unheated chert—silica solubility and effective porosity. In studies of quartz cell parameters by others, an interstitial type of solid solution seemed to cause a to increase; large increases upon heating suggest that some cherts have more structural disorganization than others, thereby retaining foreign ions admitted in heating. This behavior may be a useful indicator of chert reactivity in concrete.—GDC

02838 **Wilhelmi, Bernhard; Somerton, Wilbur H.** Simultaneous measurement of pore and elastic properties of rocks under triaxial stress conditions: Soc. Petroleum Engineers Jour., v. 7, no. 3, p. 283–294, illus., tables, 1967.

Tests were run on three outcrop sandstones at several confining pressures and axial stresses up to approximately 80 percent of failure stress. The greater reduction in porosities and permeabilities occurred in the hydrostatic loading portion of the stress cycle, but substantial reductions in both properties did occur upon application of triaxial stress. Both Young's moduli and shear moduli were found to increase with increasing confining pressure. Only very general relations were observed between pore and elastic properties. The lesser decrease in porosity and permeability

at higher stress values is related to increase in rigidity of rocks at higher stresses.—*from* Authors' abstract

02924 **Williams, Lloyd.** Heavy minerals in South Carolina: South Carolina Div. Geology Bull. 35, 35 p., illus., tables, 1967.

The Federal Bureau of Mines has recorded data on 75 heavy mineral deposits and prospects in South Carolina, most of which are placers. From information on drilling, sampling, and analysis of 11 deposits, reserves of ilmenite, rutile, zircon, and monazite have been estimated. Titanium minerals in South Carolina are normally associated with zircon and monazite; staurolite, sand, and gravel are also associated but not evaluated in this report. The most favorable deposits are on Hilton Head Island, Hollow Creek, and Horse Creek. A dredge and heavy mineral separation plant were erected at the Horse Creek deposit in 1955, and it was mined until 1958.—LLP

02703 **Williams, Roger L.** Reconnaissance of yttrium and rare-earth resources in northern New Jersey: U.S. Bur. Mines Rept. Inv. 6885, 34 p., illus., tables, 1967.

A reconnaissance of high phosphorus iron deposits, abnormally radioactive deposits, and known rare-earth bearing deposits in northern New Jersey revealed five which contained potential resources of yttrium and rare-earths. Most important of these is the Scrub Oaks mine, which is currently producing iron ore from a magnetite-hematite orebody which has a zone containing yttrium and rare-earth bearing minerals. Beneficiation studies suggest that recovery of the yttrium and rare-earths may be feasible. The other four deposits, including a pegmatite, a monazite placer, a contact zone, and an apatite deposit, are too small or low grade to be of immediate interest.—KFF

Wilson, D. W. R. *See* Brady, W. B. 02818

02777 **Wilson, J. Tuzo.** On a possible explanation for the crust's growth and movements—19th William Smith Lecture [abs.]: Geol. Soc. London Proc. 1965-66, no. 1630, p. 42-43, 1967.

02489 **Wilson, James Lee.** Cyclic and reciprocal sedimentation in Virgilian strata of southern New Mexico: Geol. Soc. America Bull., v. 78, no. 7, p. 805-817, illus., table, 1967.

Virgilian cycles of the Holder Formation in the shelf area on the northeast side of the Pennsylvanian Oro Grande basin contrast lithologically with the cycles in equivalent basinal sediments cropping out to the south and west. Basin cycles begin with cross-bedded sandstone and grade upward through relatively thick shale to a dark tidal-flat mudstone and shale. Shelf cycles contain a variable sandstone and shale lower member, with local channel-fill conglomerate. This grades upward through normal marine limestone and shale to a massive capping bed of shoal-water lime grainstone of algal-foraminiferal lime mud facies. The two sequences may be correlated by considering that sea level fluctuated repeatedly over the whole basin, and that major sedimentation alternated between the shelves and the basin.—*from* Author's abstract

Wilson, John A. *See* Maxwell, Ross A. 02908

02911 **Wilson, John A.** Early Tertiary mammals, *in* Geology of Big Bend National Park, Brewster County, Texas: Texas Univ. Pub. 6711, p. 157-169, illus., table, 1967.

Paleocene and Eocene Mammalia found in what were thought to be Late Cretaceous beds in the Big Bend area include the first remains of pantodonts, some multituberculate teeth, and a fragmentary lower jaw of a *Pleisadapsis* sp. in addition to a variety of other vertebrate fossils. Described herein are fragments of five marsupial, edentate, and ungulate families from the Black Peaks Formation, and teeth and jaw fragments of six Eocene ungulate families from the Hannold Hill and Canoe Formations, collected from scattered localities in the Park area. A

summary of the stratigraphic positions of the vertebrate faunas as of 1965 is shown in the table.—GDC

02919 **Wilson, Richard F.** Whitmore Point, a new member of the Moenave Formation in Utah and Arizona: Plateau, v. 40, no. 1, p. 29–40, illus., table, 1967.

The Moenave Formation of Late Triassic(?) age forms part of the Glen Canyon Group throughout southwestern Utah and much of northern Arizona. Over a large part of its distribution area, including the type section at Moenave, Ariz., the formation consists of two members—the Springdale Sandstone above, and the Dinosaur Canyon Member below. In both states, in the vicinity of Kanab, Utah, a grayish and reddish siltstone and claystone is present between these members that is unlike either of them in lithology. For this unit the name Whitmore Point Member is here proposed. The type section is at Whitmore Point, a promontory of the Vermillion Cliffs about five miles northwest of Pipe Spring, Ariz.—GDC

02943 **Windley, Brian F.** On the classification of the West Greenland anorthosites: Geol. Rundschau, v. 56, no. 3, p. 1020–1026, illus., 1967.

Berrangé (1966) has interpreted the West Greenland anorthosites as orogenic-plutonic types. Recent work, however, shows that in the central high-grade region of Fiskenaesset nearly all the anorthosite horizons have intense chromite layering; they were metamorphosed under granulite facies conditions and subsequently retrogressed. It is concluded that these anorthosites as a whole are pre-orogenic stratiform types, most of their present features being of secondary origin and not to be confused with those of orogenic-plutonic association.—DBV

Winniford, R. S. *See* Witherspoon, P. A. 02775

02883 **Winter, T. C.; Maclay, R. W.; Pike, G. M.** Water resources of the Roseau River watershed, northwestern Minnesota: U.S. Geol. Survey Hydrol Inv. Atlas HA-241, 3 sheets, scale 1:250,000, text, 1967.

Sheet 1 contains information on the physical setting of the Roseau River watershed, water management, ground-water development, water budget, and summary of water resources. Sheet 2 on surface water includes maps and graphs. On sheet 3 is a block diagram, a map showing thickness of glacial drift, a chart indicating characteristics and appraisal of aquifers, and information on water quality. Aquifers are surficial sand and sand within till with yields to wells of about 20 gpm. Ground-water development is confined largely to a 470 sq mi area in the central part and no decline in water levels has occurred. Moderate supplies of ground water for domestic and small industrial and community supplies are available at most places; it is very hard, high in iron content, and ranges widely in total dissolved-solids content.—MCM

Winter, T. C. *See* Maclay, R. W. 02920

02775 **Witherspoon, P. A.; Winniford, R. S.** The asphaltic components of petroleum, Chap. 6 *in* Fundamental aspects of petroleum geochemistry (B. Nagy and U. Colombo, editors): Amsterdam and New York, Elsevier Publishing Co., p. 261–297, illus., tables, 1967.

Asphaltic components are aggregates of complex structure, classified as nonhydrocarbon because they contain, besides hydrogen and carbon, significant amounts of nitrogen, sulfur, and oxygen. Too small to be seen without being removed from their natural environment or changed somewhat, ultracentrifuge studies have proven the existence of asphalts as colloids. Such compounds tend to concentrate at interfaces, affecting also the wettability of the solid phase between oil and water. In sedimentary rocks interface forces, magnified in their effect, may play an important part in the multiphase flow of oil and water, and in turn in both migration and accumulation of petroleum as well as its economic exploitation.—GDC

03019 **Withrow, Phil C.** A basis for Red Fork Sand exploration in northwest Oklahoma [abs.]: Shale Shaker, v. 18, no. 1, p. 15, 1967.

02579 **Wobus, Reinhard Arthur.** Petrology and structure of Precambrian rocks of the Puma Hills, southern Front Range, Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3573B, 1967.

02457 **Wolfe, Jack A.; Leopold, Estella B.** Neogene and early Quaternary vegetation of northwestern North America and northeastern Asia, *in* The Bering Land Bridge (D. M. Hopkins, editor): Stanford, Calif., Stanford Univ. Press, p. 193–206, illus., 1967.

The Mixed Mesophytic Forest of early and middle Miocene was continuous from Japan through Alaska into conterminous northwestern United States. At high altitudes, mixed conifer–broad leaved–deciduous forests were present. In late Miocene, a severe decline in summer temperatures in Alaska resulted in disjunction of this forest, and development of a rich conifer–dominated forest with a few hardwood species. This Boreal Forest was gradually impoverished in Pliocene, but survives today in such areas as the Amur River valley and coastal Oregon and Washington. By early Pleistocene, forests of the North Pacific basin were similar to those today; a few exotic plants persisted locally, but mixed forest–tundra was present in Beringia. The Boreal Forest probably was partitioned originally by edaphic factors and opening of Bering Strait, and during the Pliocene by edaphic and climatic factors.—ESL

02437 **Wollenberg, Harold A.; Smith, Alan R.; Bailey, Edgar H.** Radioactivity of Upper Mesozoic graywackes in the northern Coast Ranges, California: Jour. Geophys. Research, v. 72, no. 16, p. 4139–4150, illus., table, 1967.

Gamma-radiation was measured and graywackes of the Franciscan Formation, the coastal belt, and the great valley sequence were sampled on traverses across the Coast Ranges north of San Francisco. Samples were analyzed for U, Th, and K, and K-feldspar contents were determined. The K-feldspar content has little effect on radioactivity or heat production of the three rock units. Low-temperature high-pressure metamorphism is not related to K-feldspar content; radioactivity tends to decrease with increasing grade of metamorphism. Th/U ratios fall within the range typical of eugeosynclinal sediments and are like Th/U ratios in granitic rocks of the Sierra Nevada, the suggested source area. U, Th, and K concentrations of the graywackes are compatible with those of a cratonal source.—DBV

02795 **Wosincki, J. F.; Beall, G. H.; MacDowell, J. F.** Devitrification of tektite glass: Nature, v. 215, no. 5103, p. 839–841, illus., tables, 1967.

Two types of experiments relevant to the origin of tektites were performed, one involving heat treatment of supercooled glass above the strain point, and the other crystallization of tektite liquid on slow cooling from the melt. The tendency for hypersthene devitrification on heating is greatest among the moldavites and North American tektites and seems to be related to composition. The great instability of the low-silica indochinites suggests that tektites with even less silica may exist in a devitrified form difficult to distinguish from many common rocks. The ease of internal crystallization of southeast Asian tektite glass on slow cooling severely limits the size of the parent mass unless this mass was either not formed by conventional melting above the liquidus, was substantially crystalline, or was never cooled below the liquidus before breakup.—DBV

02858 **Wright, H. E., Jr.** A square-rod piston sampler for lake sediments: Jour. Sed. Petrology, v. 37, no. 3, p. 975–976, illus., 1967.

The Livingstone–Vallentyne piston sampler has been further modified by replacing the spring catch with splines on a square rod, in order to strengthen the critical points of greatest stress and permit pounding when necessary.—Author's abstract

Wyllie, P. J. *See* Scarfe, C. M. 02674

02801 **Yamamoto, Teruo; Anderson, Henry W.** Erodibility indices for wildland soil of Oahu, Hawaii, as related to soil forming factors: Water Resources Research, v. 3, no. 3, p. 785–798, illus., tables, 1967.

Soil samples collected in the watersheds of the Koolau and Waianae ranges were analyzed in the laboratory for the size distribution of water-stable aggregates and suspension percent. Indices of erodibility were related by principal component analyses with varimax rotation to 7 soil-forming factors: parent material, rainfall, elevation, vegetation type, slope, aspects, and zone. Parent rock material was the most important in explaining variation of water-stable aggregates. The loose condition plus the dispersive and slaking characteristics of volcanic ash soils suggest that they may be twice as erodible as soils of basaltic flow or of the colluvium origin. Since the suspension percent was found to be independent of other measures, it may serve well as part of an erodibility ratio.—*from* Authors' abstract

Yardley, D. H. *See* Sims, P. K. 02855

02476 **Yerkes, R. F.; Gorsline, D. S.; Rusnak, G. A.** Origin of Redondo submarine canyon, southern California, *in* Geological Survey research 1967, Chap. C: U.S. Geol. Survey Prof. Paper 575-C, p. C97-C105, illus., 1967.

Redondo submarine canyon trends WSW for about 15 km from its head near the shorelineat Redondo Beach, 4 km north of the Palos Verdes Hills and 45 km southwest of Los Angeles, Calif. The canyon is unusually straight and has a V-shaped cross section. Continuous reflection profiles show the canyon formed along a structural trough created chiefly by faulting in middle Pleistocene during relative uplift of the Palos Verdes Hills structural block south of the canyon. Subaerial erosion of the canyon head early in late Pleistocene is suggested by the presence, directly inland from the canyon head, of a buried westward-sloping channel. Down-canyon movement of longshore-drifted sediment has modified the head, maintained the canyon below the level of low sea stands, contributed sediment to the submarine fan at the canyon mouth, and eroded or maintained the leveed channels that incise the length of the fan.—*from* Authors' abstract

Yoder, H. S., Jr. *See* Tilley, C. E. 02629

02652 **Yoder, H. S., Jr.** Spilites and serpentinites: Carnegie Inst. Washington Yearbook 65, 1965-66, p. 269-279, illus., table, 1967.

In the present study, the mineral assemblage of spilites has been examined and reduced to an amenable number of variables by considering only those rocks of simple mineralogy that were regionally unmetamorphosed and essentially free of calcite. Examination of such specimens reveals that the critical assemblage is plagioclase+chlorite+clinopyroxene. Most critical is the limitation of most plagioclase An_{0-8}, which often surrounds relics of a more basic plagioclase. Chemical analyses of the calcite-free assemblages show that they do not differ much from basalt in composition if the relatively high water content of the spilites is excepted; many have low K_2O and high Na_2O compared with average basalts.—MST

Yoder, H. S., Jr. *See* Schairer, J. F. 02657

Yoder, H. S., Jr. *See* Schairer, J. F. 02714

Yoder, H. S., Jr. *See* O'Hara, M. J. 02884

02625 **Young, Chapman, 3d.** Applications of dislocation theory to upper-mantle deformation [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 10, p. 3575B, 1967.

02914 **Zumberge, James H.** Laboratory manual for physical geology (3d edition): Dubuque, Iowa, Wm. C. Brown Co., 74 p., illus., tables, 1967.

The exercises and problems in this laboratory manual are designed to develop the student's reasoning ability in addition to teaching him terminology and basic facts. Reproductions of parts of standard U.S. Geological Survey maps are used in many of the exercises. Subjects covered are: minerals, rocks, topographic maps, aerial photographs, geologic interpretation of topographic maps, and structural geology.—LLP

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Marc
M
Econom
Coal
Ba
Meta
ar
Oil s
Jo
Engine
Eart
da
Eart
tra
02
Shot
02
Genera
Beri

INDEX

[The numbers refer to entries in the abstracts]

Absolute age, dates
Carbon-14
Continental slope off Washington, Mt. Mazama ash layer: Royse, Chester F., Jr. 02757
South Carolina, Botany Bay Island, marine shells: Hoyt, John H. 02844
Granite
Newfoundland, southeastern, Precambrian, interpretation: Rose, E. R. 02900
Igneous rocks
Maine, Shirley-Blanchard stock, Moxie pluton: Espenshade, G. H. 02763
Metamorphic rocks
Ontario, Grenville province, whole rock, interpretation: Davis, G. L. 02736
Ore deposits
North Carolina, Ore Knob copper deposit: Kinkel, Arthur R., Jr. 02753

Absolute age, methods
Rubidium-strontium
Whole-rock ages, interpretation, Grenville province, Ontario: Davis, G. L. 02736
Uranium inequilibrium
Molluscan shells, marine, applicability: Blanchard, R. L. 02448

Alabama
Paleontology
Foraminifera, Paleocene, *Ostrea thirsae* beds: Smith, Charles Culberson. 02875
Petrology
Northern, Chesterian rocks: Emerson, John Wilford. 02564
Stratigraphy
Mississippian, Chesterian rocks, northern: Emerson, John Wilford. 02564
Paleocene, Nanafalia Formation, *Ostrea thirsae* beds: Smith, Charles Culberson. 02875

Alaska
Earthquakes
March 28, 1964, south-central, effects, transportation, utilities: Eckel, Edwin B. 02897
March 1964, Alaskan Railroad damage: McCulloch, David S. 02707
Economic geology
Coal, Cape Lisburne-Colville River region: Barnes, Farrell F. 02435
Metals, Chugach Mountains, Metal Creek area: Richter, Donald H. 02898
Oil shale, Arctic Slope, possibilities: Donnell, John R. 02704
Engineering geology
Earthquakes, Alaskan Railroad, 1964 damage: McCulloch, David S. 02707
Earthquakes, March 28, 1964, effects, transportation, utilities: Eckel, Edwin B. 02897
Shorelines, Barrow area: Hume, James D. 02680
General
Bering land bridge: Hopkins, David M. 02418

Alaska
Geochemistry
Chugach Mountains, Metal Creek area, geochemical prospecting: Richter, Donald H. 02898
Geomorphology
Barrow area, sediment transport, 1948-63: Hume, James D. 02680
Gulf of Alaska, submarine physiographic provinces: McManus, Dean A. 02758
Seward Peninsula, western, terraces, wavecut: Sainsbury, C. L. 02456
Geophysical surveys
Gulf of Alaska, abyssal plains, seismic: Hamilton, Edwin L. 02439
Gulf of Alaska, echo sounding, review: McManus, Dean A. 02758
Resurrection Bay, seismic cross sections: Rusnak, Gene A. 02474
Glacial geology
Chukchi Sea coast, Quaternary deposits: McCulloch, D. S. 02455
Seward Peninsula, western, influence on animal migration: Sainsbury, C. L. 02456
Yukon-Tanana upland, multiple glaciation features: Pewe, Troy L. 02811
Hydrogeology
Ocean Cape, ground-water resources, infiltration gallery: Feulner, Alvin J. 02590
Maps, geologic
Cape Lisburne-Colville River region, coal-bearing rocks: Barnes, Farrell F. 02435
Maps, geomorphologic
Yukon-Tanana upland, Quaternary glaciation, extent: Pewe, Troy L. 02811
Mineralogy
Cristobalite, clinoptilolite in bentonite: Reynolds, R. C., Jr. 02861
Paleontology
Flora, Neogene-Pleistocene, distribution, stages: Wolfe, Jack A. 02457
Mammalia, Quaternary, pre-Wisconsin, list: Pewe, T. L. 02459
Mollusca, Pleistocene, stratigraphic distribution: Hopkins, David M. 02454
Palynomorphs, Quaternary, lowlands, vegetation history: Colinvaux, Paul A. 02419
Sedimentary petrology
Gulf of Alaska, glacial and postglacial sediments: Gershanovich, D. E. 02453
Stratigraphy
Quaternary, Chukchi Sea coast: McCulloch, D. S. 02455
Quaternary, western coastal areas, marine transgressions: Hopkins, David M. 02454
Structural geology
Gulf of Alaska, wrench-fault system: Stoneley, R. 02782
Strike-slip faults, regional: Grantz, Arthur. 02607

Alberta
Glacial geology
Southwestern, Rocky Mountain and Laurentide chronologies, correlation: Wagner, William Philip. 02622
Paleontology
Fauna, Devonian, Cairn Formation, reef complex, Miette area: Noble, James Peter Allison. 02616
Sedimentary petrology
Miette area, Devonian, reef complex, Cairn Formation: Noble, James Peter Allison. 02616
Stratigraphy
Quaternary, Rocky Mountain and Laurentide tills, correlation: Wagner, William Philip. 02622

Aluminum
Colorado
Piceance Creek basin, Green River oil shale, possibilities: Hite, Robert J. 02690
Geochemistry
Stability, form, in natural water: Hem, J. D. 02826
Sulfatization, kinetics: Chao, Tze. 02577

Angiosperms
Lupinus arcticus
Pleistocene, seeds, Yukon, laboratory germination: Porsild, A. E. 02944
Mimulus gattatus
Quaternary, Utah, Bonneville Basin, evolution: Lindsay, Delbert W. 02990

Annelida
Polychaeta
Recent, Massachusetts, Cape Cod area, sediment disturbance: Rhoads, Donald C. 02892

Appalachians
Economic geology
Copper, massive sulfides, deposits: Kinkel, Arthur R., Jr. 02753
Sedimentary petrology
Catskill red beds, coloration, genesis: Friend, P. F. 02783
Structural geology
Nappe structures, slip-line orientations: Hansen, Edward. 02715

Arctic
General
Bering land bridge: Hopkins, David M. 02418
Bibliography, abstracts: Tremaine, Marie. 02815
Glacial geology
Research program, review: Glaciology Panel. 02681

Arctic Ocean
Geomorphology
Mid-Oceanic Ridge, description: Johnson, G. Leonard. 02792

Arizona
Geomorphology
Southwestern, pediment formation, floods: Rahn, Perry H. 02981

Arizona
Geophysical surveys
Ajo area, heat flow measurements: Bell, Peter M. 02689
Paleomagnetism
Quaternary, fire-pit clays, Snaketown ruins: Weaver, Kenneth F. 02675
Petrology
Ajo area, Cornelia granitic stock cf. Boulder batholith, Colo.: Wadsworth, William Bingham. 02578
Sedimentary petrology
Safford area, Pliocene–Pleistocene basin facies: Harbour, Jerry. 02608
San Pedro Valley, Saint David Formation: Gray, Robert S. 02853
Stratigraphy
Devonian–Permian, Mogollon Rim: Peterson, Willis. 02917
Pliocene–Pleistocene, Basin Fill, Safford area: Harbour, Jerry. 02608
Pliocene–Pleistocene, Saint David Formation, San Pedro Valley: Gray, Robert S. 02853
Triassic(?), Moenave Formation, Whitmore Point Member, new: Wilson, Richard F. 02919
Structural geology
Mogollon Rim, fault scarp, popular account: Peterson, Willis. 02917
Shylock fault zone, wrench fault and piercement structure: Anderson, C. A. 02470

Arkansas
Hydrogeology
Jackson, Independence Counties, ground water, resources: Albin, Donald R. 02827
Maps, ground water
Jackson, Independence Counties: Albin, Donald R. 02827
Paleontology
Foraminifera, Cretaceous, Upper, southwestern, planktonic: Pessagno, Emile A., Jr. 02760
Sedimentary petrology
Northern, Fayetteville Formation, slump features: Spreng, A. C. 02866

Associations
American Geological Institute
Reorganization, 1960 63: Beebe, B. Warren. 02429
Internat. Assoc. Quaternary Research
Commission on Shorelines, history and work: Fairbridge, Rhodes W. 02824
Symposium, Bering land bridge: Hopkins, David M. 02418
Natl. Sci. Foundation Adv. Sci. Seminar
Forest hydrology, watershed research symposium: Sopper, William E. 02784

Atlantic Ocean
Geomorphology
Continental slope off New York, buried knoll and sediment drift: Lowrie, Allen, Jr. 02685
Landform evolution: King, Lester C. 02828

Atlantic Ocean
Geophysical surveys
Mid-Atlantic Ridge at 45° N., magnetic anomaly pattern analysis: Matthews, D. H. 02581
Mid-Atlantic Ridge near 27° N., magnetic, interpretation: Phillips, J. D. 02665
Mineralogy
Heavy minerals, Gulf of Maine, nearshore sediments, provenance: Ross, David A. 02473
Paleomagnetism
Mid-Atlantic Ridge, sea-floor spreading evidence: Phillips, J. D. 02665
Paleontology
Mollusca, Cenozoic, Pacific origin, transarctic migration: Durham, J. Wyatt. 02428
Sedimentary petrology
Gulf of Maine, nearshore sediments, provenance: Ross, David A. 02473
Mid-Atlantic Ridge, sediments, provenance: Siever, Raymond. 02839
Structural geology
Mid-Atlantic Ridge, dike injection pattern: Matthews, D. H. 02581
Mid-Atlantic Ridge, sea-floor spreading: Phillips, J. D. 02665
Mid-Atlantic Ridge, tectonics, Vema Fracture offset: vanAndel, Tjeerd H. 02840
Atmosphere
Origin
Chemical reactions in primitive stage: Abelson, P. H. 02731
Automatic data processing
Crystallography
X-ray data, interpretation, computer program: Gabe, E. J. 02676
Engineering geology
Soils, retrieval systems, descriptors: Am. Society of Civil Engineers. 02706
General
Earth models: Backus, G. E. 02948
Geophysical surveys
Gravity, reduction method, topographic effect: Takin, M. 03009
Seismic, body-wave interpretation, technique: Archambeau, C. B. 03008
Hydrogeology
Digital simulation, model, hydrologic cycle: Crawford, Norman H. 02785
Mineralogy
Formula derivation from analyses, anion-based, hydrogen-equivalent method: Jackson, Everett D. 02465
Sedimentary petrology
Sedimentary structure orientations: Agterberg, F. P. 02832
Seismic methods
Data reduction, Northwest Territories, Yellowknife array: Weichert, D. H. 02514
Stratigraphy
Fluvial sandstone body, vertical profile, model: Potter, Paul Edwin. 02837
Technique, trend-analysis: Schramm, Martin W., Jr. 03028
Bacteria
Sulfur-oxidizing
Nevada, Steamboat Springs soil samples: Ehrlich, Garry G. 02478
Bahamas
Geochemistry
Sea water and plankton, radium content: Szabo, B. J. 02584
Sedimentary petrology
Bimini Lagoon, carbonate sediments, oolitic-coated grains: Bathurst, R. G. C. 02452
Great Bahama Bank, sedimentation, facies, counterpart in Florida: Hoffmeister, J. Edward. 02512
Barbados
Geochemistry
Carbonate sediments, precipitation, lithification: Fischer, Alfred G. 02931
Barite
California
Shasta County, Glidden Company deposit, occurrence: Weber, F. Harold, Jr. 02968
Nevada
East Northumberland Canyon, occurrence: Shawe, D. R. 02433
Basins, structural
Mechanism of formation
Virginia, Shenandoah Valley: Bott, M. H. P. 02779
New Mexico
Oro Grande basin, Virgilian cycles: Wilson, James Lee. 02489
Oklahoma-Texas
Dalhart basin: Dobervich, George. 03032
Sedimentation
Arizona, Safford area: Harbour, Jerry. 02608
Batholiths
Structure
Interpretation, gravity anomalies, shape and mass distribution: Bott, M. H. P. 02491
Bentonite
Alaska
Northern, Colville Group, mineralogy: Reynolds, R. C., Jr. 02861
Missouri
Southeastern, mineralogy, occurrence: Beall, Arthur O., Jr. 02863
United States
Western, characteristics, genesis: Menze, R. J. 02856
Wyoming
Black Hills district, occurrence: Menze, R. J. 02856
Bibliography
Arctic
General, abstracts: Tremaine, Marie. 02815
Salt domes
United States, Mexico, Gulf coast region: Halbouty, Michel T. 02894
Snow, ice, and frozen ground
Cold regions, engineering problems: U.S. Library of Congress. 02510

Biography
Levorsen, Arville Irving: Illing, V. C. 02781
Lonsdale, John Tipton: Maxwell, Ross A. 02909
Wager, Lawrence Rickard: Deer, W. A. 02780

Bitumens
Geochemistry
Asphaltic components of petroleum, colloidal form: Witherspoon, P. A. 02775
Trinidad
Asphalt lake, aliphatic and alicyclic hydrocarbons: Ponnamperuma, Cyril. 02495

Brachiopoda
Dalmanella bassleri
Ordovician, Kentucky, Lexington Limestone, redescription: Neuman, Robert B. 02767
Dalmanella sulcata
Ordovician, Kentucky, Lexington Limestone, redescription: Neuman, Robert B. 02767
Heterorthina, n.sp.
Ordovician, Kentucky, Lexington Limestone: Neuman, Robert B. 02767
Pionodema, n.sp.
Ordovician, Kentucky, Lexington Limestone: Neuman, Robert B. 02767
Pionomena, n.sp.
Ordovician, Kentucky, Lexington Limestone: Neuman, Robert B. 02767
Plectatrypa
Silurian, taxonomy, evolution, distribution: Boucot, A. J. 02885
Spirigerina (Eospirigerina), n. subgen.
Ordovician–Silurian, taxonomy, evolution, distribution: Boucot, A. J. 02885
Taxonomy
Atrypidae, Ordovician–Silurian: Boucot, A. J. 02885

Breccia
Collapse
Nova Scotia, Windsor Group: Clifton, H. Edward. 02677
Utah
Cherry Creek area, volcanic pipes: Morris, Hal T. 02471

Brines
California
Salton Sea, geothermal, sulfide minerals: Skinner, Brian J. 02694
Geochemistry
Ion activity products, calculation: Polzer, W. L. 02480
Production
Concentrated mineral salts, oil-field possibilities: Angino, Ernest E. 02954
Utah
Bonneville Salt Flats, brine minerals, ion activity products, calculation: Polzer, W. L. 02480

British Columbia
Geochemistry
Strait of Georgia, Saanich Inlet, diatomaceous sediments, elements: Gross, M. Grant. 02899

British Columbia
Petrology
Vancouver Island, Buttle Lake area, Karmutsen Group, alteration: Surdam, Ronald Clarence. 02544

California
Areal geology
Yosemite National Park, guidebook: Scharff, Robert. 02755
Earthquakes
Prediction, risk map: Lomnitz, C. 03010
Economic geology
Barite, Shasta County, Glidden Company deposit: Weber, F. Harold, Jr. 02968
Mercury, Wilbur Springs district, genesis: Moisseeff, Alexis Nicolas. 02615
Natural gas, Shale Flats field, Mabury sandstone: Anderson, David N. 02939
Natural gas, Shale Point field, Mabury sandstone: Anderson, David N. 02938
Natural gas, Willows–Beehive Bend field: Barger, R. M. 02937
Petroleum, Castaic Junction field, occurrence: Cordova, Simon. 02935
Petroleum, Long Beach field, Recreation Park area, occurrence: Ingram, William L. 02936
Petroleum, natural gas, Edison field, Main area: Barnes, J. A. 02940
Petroleum, Ojai field, North Sulphur Mtn. area: Mitchell, William Spencer. 02941
Engineering geology
Foundations, central, Dos Amigos pumping plant, rebound: Bara, John P. 02708
Landslides, control problem: Cleveland, George B. 02916
Materials, concrete aggregates, sand attrition test: Tuthill, L. H. 02890
Geochemistry
Coast Ranges, northern, Mesozoic graywackes, radioactivity: Wollenberg, Harold A. 02437
Salton Sea, geothermal brine, sulfides: Skinner, Brian J. 02694
Wilbur Springs quicksilver district, hydrothermal transport of mercury: Moisseeff, Alexis Nicolas. 02615
Geomorphology
Alluvial fans, processes: Hook, Roger LeB. 02933
Death Valley, tectonic control: Pouquet, Jean. 02825
Middle Fork Eel River erosion, bed-material movement: Ritter, John R. 02594
Oceano area, coastal dunes: Matthews, Jerry Lee. 02613
Redondo submarine canyon, genesis: Yerkes, R. F. 02476
Geophysical surveys
Redondo submarine canyon, seismic cross sections: Rusnak, Gene A. 02474
Hydrogeology
Pahrump Valley, ground-water reservoirs, pumping effects: Malmberg, Glenn T. 02745

California
Hydrogeology
Research, Stanford Univ., hydrologic cycle, model, digital simulation: Crawford, Norman H. 02785
Maps, geologic
Condrey Mountain quadrangle: Hotz, P. E. 02725
Pahrump Valley: Malmberg, Glenn T. 02745
Soldier Pass quadrangle: McKee, E. H. 02553
Maps, ground water
Pahrump Valley: Malmberg, Glenn T. 02745
Maps, mineral resources
Northern, selected minerals: Smith, Merritt B. 02999
Maps, seismicity
Earthquake risk: Lomnitz, C. 03010
Maps, structure
Castaic Junction oil field: Cordova, Simon. 02935
Edison field, Main area: Barnes, J. A. 02940
Long Beach oil field, Recreation Park area: Ingram, William L. 02936
Ojai oil field, North Sulphur Mtn. area: Mitchell, William Spencer. 02941
Shale Flats gas field: Anderson, David N. 02939
Shale Point gas field: Anderson, David N. 02938
Willows Beehive Bend gas field: Barger, R. M. 02937
Marine geology
Ecology, invertebrates, intertidal sands, Tomales Bay: Johnson, Ralph Gordon. 02987
Mineralogy
Omphacite, Pacific margin, Franciscan glaucophane schist: Essene, E. J. 02673
Opal, Mojave Desert, optical properties: Sanders, J. V. 02830
Paleontology
Foraminifera, Cretaceous, Sacramento Valley, planktonic: Douglas, Robert Guy. 02604
Foraminifera, Permian, Calaveras Formation: Douglass, Raymond C. 02770
Petrology
Northwestern, blueschist belt below thrust, metamorphic zonation: Blake, M. C., Jr. 02462
Owlshead Peak, White Mts., metamorphic aureole, zircon alteration: Gastil, R. Gordon. 02499
Pacific margin, Franciscan glaucophane schist, omphacitic facies: Essene, E. J. 02673
Sedimentary petrology
Mugu Lagoon, recent sediments: Warme, John Edward. 02623
Oceano area, coastal dunes, grain-size distribution, crossbedding: Matthews, Jerry Lee. 02613
Paso Robles Formation, provenance: Galehouse, Jon Scott. 02566

California
Stratigraphy
Condrey Mountain quadrangle, sections: Hotz, P. E. 02725
Cretaceous–Pliocene, Sacramento Valley, correlation sections, nomenclature: Sullwold, Harold H., Jr. 02926
Pliocene, Paso Robles Formation, provenance, paleocurrents: Galehouse, Jon Scott. 02566
Soldier Pass quadrangle, sections: McKee, E. H. 02553
Structural geology
Hollister area, active faults, near Calaveras fault zone: Rogers, Thomas H. 02998
Palmdale area, San Andreas fault zone: Evans, James George. 02565
San Andreas fault, piezomagnetic changes preceding creep: Breiner, Sheldon. 02945
Tectonics, control of geomorphic features: Pouquet, Jean. 02825
Weathering
White Mountains, limestone and dolomite, metamorphosed: LaMarche, Valmore C., Jr. 02466
Cambrian
Missouri
Southeastern, Lamotte Formation, bentonite: Beall, Arthur O., Jr. 02863
New York
Dekalb area, Potsdam Sandstone: Bloomer, R. O. 02497
Dekalb area, Potsdam Sandstone: Brown, J. S. 02582
Pennsylvania
Dauphin County, Great Valley carbonate formations, revision: MacLachlan, David B. 02878
Canada
Economic geology
Mineral resources, shield, relation to geochronologic provinces: Sarcia, Jacqueline. 02971
Petroleum, natural gas, exploration, neutron log: Smith, W. D. M. 02831
General
Organizations, government, commercial, societies, universities: Ogilvie, W. P. 02879
Geomorphology
Permafrost, zones and distribution: Brown, R. J. E. 02888
Maps, permafrost
Zones, continuous and discontinuous: Brown, R. J. E. 02888
Carbon
Isotopes
C-13, biogenic carbonates: Weber, Jon N. 02727
C-14, decay of excess from nuclear event: Plesset, Milton. 02507
C-13, Gulf Coast salt-dome cap rock: Cheney, E. S. 02716
Fractionation, C–O–H gas–aqueous system: Deuser, W. G. 02663

Carboniferous
Nevada
Independence Range, Schoonover group: Fagan, John J. 02606
North America
Sedimentation cycles, mechanism: Bott, M. H. P. 02779
Caribbean Sea
Paleoclimatology
Quaternary, temperature curve: Donn, William L. 02834
Cartography
Methods
Geomorphology, classification of landforms, legend, genetic base: Ritchot, Gilles. 02881
Caves
Idaho
Crystal Ice Caves, genesis: Papadakis, Jim. 02738
Iowa
Dutton's Cave, vertical shaft, retreatal gorge: Hedges, James A. 02905
Minnesota
Southeastern, limestone and sandstone: Hogberg, R. K. 02751
Puerto Rico
Rio Camuy Cave area, karst, types: Thrailkill, John V. 02741
Cenozoic
Alaska
Gulf of Alaska sedimentary province: Stoneley, R. 02782
Arizona
Safford area, Pliocene–Pleistocene sediments: Harbour, Jerry. 02608
San Pedro Valley, Saint David Formation: Gray, Robert S. 02853
Mammalia
Marine, migrations, possible transarctic: Scheffer, Victor B. 02422
Mollusca
Transarctic marine migrations: Durham, J. Wyatt. 02428
Nevada
Virginia City area, Lousetown Formation, lava flows: Heinrichs, Donald Frederick. 02624
Ceramic materials
South Carolina
Sillimanite, concentrations from ore deposits: Redeker, Immo H. 02845
Changes of level
Alaska
Quaternary, Chukchi Sea: McCulloch, D. S. 02455
Quaternary, marine transgressions, relation to interglacials: Hopkins, David M. 02454
California
Quaternary, Palos Verdes Hills–Redondo canyon area: Yerkes, R. F. 02476
Correlation
Georgia, Pleistocene shorelines, cf. Africa: Hoyt, John H. 02814
Changes of level
New Mexico
Pennsylvanian, Holder Formation, alternating shelf and basin cycles: Wilson, James Lee. 02489
Chemical analysis
Sample preparation
Gold ore, solvent extraction technique: Huffman, Claude, Jr. 02434
Wet Technique, palladium in rocks, spectrophotometric method: Grimaldi, F. S. 02485
Clay mineralogy
Areal studies
Georgia, Altamaha River watershed, basin sediments: Jinks, Douglas David. 02626
Minnesota, Glenwood Formation: Parhat Walter. 02865
Missouri, Lamotte Formation, bentonite: Beall, Arthur O., Jr. 02863
Oklahoma, Arkansas River water at Ponca: Weaver, Charles E. 02859
Oklahoma, Arkoma basin, source areas: Manley, Fred H., Jr. 02986
Pennsylvania, Clearfield County, underclays, alteration: Jaron, Michael G. 02868
Experimental studies
Axial ratio, determination method: Street, Norman. 02862
Coupled flow phenomena, clay–water systems: Gray, Donald Harford. 02558
Dehydration, weight-loss-determination techniques: Kerns, Raymond L., Jr. 02871
Electrical properties, relation to structure: Arulanandan, Kandiah. 02556
Hydroxy-aluminum, interlayers in montmorillonite, infrared studies: Weismiller, R. A. 02994
Montmorillonite–water mixtures, frozen, water content from heat capacity: Anderson, Duwayne M. 02821
Soils, pH, cation exchange: deVilliers, J. M. 02995
Techniques, particle-size separation: Kerns, Raymond L., Jr. 02513
Clays
Properties
Strength, progressive failure, causes: Bjerrum, Laurits. 02710
Coal
Alaska
Cape Lisburne–Colville River region, resources: Barnes, Farrell F. 02435
Indiana
Southwestern, resources: Rooney, Lawrence F. 02874
Kentucky
Prestonsburg quadrangle, resources: Rice, Charles L. 02721
Williamsburg quadrangle, resources: Tabor, Rowland W. 02724

Coal
Pennsylvania
California quadrangle, resources: Schweinfurth, Stanley P. 02722
Colorado
Areal geology
Ralston Buttes district: Sheridan, Douglas M. 02768
San Juan Mountains, Mount Wilson quadrangle: Bromfield, Calvin S. 02810
Economic geology
Aluminum, sodium carbonate, Piceance Creek basin,occurrence in oil shale: Hite, Robert J. 02690
Petroleum, Las Animas arch, occurrence: Clair, Joseph R. 03031
Uranium, Ralston Buttes district, occurrence: Sheridan, Douglas M. 02768
Geomorphology
Great Sand Dunes Natl. Monument, dune types, genesis: Johnson, Ross B. 02588
Hydrogeology
Ground water, resources, development: Cornish, Earl. 02759
Maps, geologic
Mount Wilson quadrangle: Bromfield, Calvin S. 02810
Ralston Buttes district: Sheridan, Douglas M. 02768
Petrology
IdahoSprings area, Boulder Creek granitic phacolith, cf. Cornelia stock, Ariz.: Wadsworth, William Bingham. 02578
Puma Hills, Precambrian rocks: Wobus, Reinhard Arthur. 02579
Sedimentary petrology
BijouCreek, flood deposits: McKee, E. D. 02857
Stratigraphy
Paleozoic, pre-Permian, Las Animas arch: Clair, Joseph R. 03031
Precambrian–Quaternary, sections: Cornish, Earl. 02759
Structural geology
Idaho Springs area, anticline, control of Boulder batholith: Wadsworth, William Bingham. 02578
Puma Hills, deformation, Precambrian rocks: Wobus, Reinhard Arthur. 02579
Connate water
Immobility
Permeable sandstone, causes: Manger, G. Edward. 02591
Texas
Karnes County, Eocene sandstone, immobility: Manger, G. Edward. 02591
Connecticut
Engineering geology
Shorelines,beach stabilization, Westport area: Vesper, William H. 02511
Maps, geologic
Springfield (Mass.) South quadrangle: Hartshorn, Joseph H. 02705
Conodonts
Mississippian
Idaho, Milligen Formation, correlation with Lodgepole Limestone, Montana: Sandberg, Charles A. 02482
Construction materials
Concrete aggregates
Sand quality, attrition test, petrographic analysis: Davis, R. E. 02889
Exploration
Photogeology, interpretation, Kansas: Stallard, Alvis H. 02964
Indiana
Properties, Mississippian limestones, evaluation: West, Terry R. 02965
Ohio
Chert, properties: Kneller, William A. 02958
Properties
Aggregate sand, attrition test: Tuthill, L. H. 02890
Aggregates, evaluation for architectural concrete: Cutcliffe, William E. 02949
Chert, variation with heat: Wilband, John T. 02957
Concrete aggregates, sand quality, attrition tests, correlation: Chamberlin, W. P. 02979
Continental margin
California
Redondo submarine canyon, genesis: Yerkes, R. F. 02476
Slope off Santa Rosa Island, dolomite boulder: Pierce, J. W. 02835
Florida
Shelf, sediments, composition, distribution: Earley, Charles F. 02966
Georgia
Bottom features, television system: Eddy, J. E. 02472
New England
Shelf, Long Island Sound to Buzzards Bay, seismic profile: Tagg, A. Richard. 02475
New Jersey
Shelf, surface features, under-water surveying instrument: Reidy, F. A. 02978
New York
Hudson Canyon area, buried knoll and sediment drift: Lowrie, Allen, Jr. 02685
Newfoundland
Shelf, surface features, under-water surveying instrument: Reidy, F. A. 02978
Oregon
Shelf, sediments: Gross, M. Grant. 02867
Shelf
Inner, sediment types, relation to climate: Hayes, Miles O. 02451
Washington
Shelf, sediments: Gross, M. Grant. 02867
Willapa submarine canyon, ash layer in core, Mazama origin: Royse, Chester F., Jr. 02757
Copper
Geochemistry
Geothermal brine, California: Skinner, Brian J. 02694

Copper
Haiti
Meme Casseus district, genesis, occurrence: Kesler, Stephen Edward. 02612
Minnesota
Duluth Gabbro Complex, sulfides, exploration: Sims, P. K. 02855
Nevada
Eureka County, resources, production: Roberts, Ralph J. 02975
Tem-Piute, occurrence: Buseck, Peter R. 02695
North Carolina
Ore Knob mine, occurrence: Kinkel, Arthur R., Jr. 02753
Ontario
Porcupine district, Canadian Jameison mines, occurrence: Mining in Canada. 02630

Core
Processes
Surface flow, relation to magnetic field, secular variation: Kahle, Anne B. 02991
Surface flow, relation to magnetic field, secular variation: Vestine, E. H. 02992
Structure
Boundary with mantle, P-waves, diffracted, interpretation: Phinney, Robert A. 03013

Correlation
Methods
Remanent magnetism, Washington, Yakima Basalt variations: Rietman, Jan David. 02618

Cratering
Field studies
Hawaii, Kapoho area, secondary volcanic impact: Hartmann, William K. 02985

Cretaceous
California
Sacramento Valley, correlation sections, nomenclature: Sullwold, Harold H., Jr. 02926
Sacramento Valley, Foraminifera, biostratigraphy: Douglas, Robert Guy. 02604
Gulf Coastal Plain
Western, Foraminifera, planktonic, Upper: Pessagno, Emile A., Jr. 02760
Mexico
Coahuila, northern, Comanche and Coahuila Series: Smith, Charles Isaac. 02619
North America
Western Interior, Pelecypoda, *Thyasira*: Kauffman, Erle G. 02988
Northwest Territories
Mackenzie, stratigraphy: Mountjoy, E. W. 02508
Texas
Big Bend National Park, igneous activity: Lonsdale, John T. 02912
Big Bend National Park, stratigraphy: Maxwell, Ross A. 02908
Big Bend National Park, stratigraphy, correlation, new names, fauna: Maxwell, Ross A. 02910

Cretaceous
Texas
Edwards Formation, paleogeography: Fiher, W. L. 02951
Yukon
Northern, stratigraphy: Mountjoy, E. W. 02508

Crust
Atlantic Ocean
Structure, tectonics, Mid-Atlantic Ridge, Vema Fracture offset: vanAndel, Tjeerd H. 02840
Genesis
Growth and movements, causes: Wilson, J. Tuzo. 02777
Physical properties
Elasticity, low-velocity zone, continental: Landisman, M. 03011
Processes
Vertical movements, electronic measurement, error correction: Thompson, M. C. 0299
Structure
Continental, refraction profiles, re-interpretation: Landisman, M. 03011
Interpretation model, theoretical seismograms: Kane, Julius. 03014
United States
Northwestern, structure, seismic data: Chiburis, Edward Frank. 02562

Crystal chemistry
Oxides
Spinel structures, iron-deficient: Kullerud, G. 02729
Sulfides
Spinel structures, iron-deficient: Kullerud, G. 02729

Crystal structure
Amphibole
Glaucophane-riebeckite series, optical indicatrix and X-ray data: Borg, I. Y. 0267
Ardennite
Cell dimensions: Donnay, Gabrielle. 0264
Chert
Variation of α-quartz with heat: Wilband, John T. 02957
Durangite
Mexico, matricial calculation: Fabregat Guinchard, Francisco J. 02873
Ferrosilite
Clino- and ortho-ferrosilite, refinement: Burnham, Charles W. 02636
Hydroxyapatite
Cell dimensions: Skinner, C. 02648
Muscovite
Polymorphism of 3T and $2M_1$ types: Guven, Necip. 02637
Rhodizite
ESR experiments, modified formula: Donnay, Gabrielle. 02638
Tourmaline
Absolute orientation: Donnay, Gabrielle. 02647

Crystallography
Methods
Matrices, use in calculation: Fabregat Guinchard, Francisco J. 02873
X-ray data, interpretation, computer program: Gabe, E. J. 02676
Deformation
Experimental studies
Mechanism, recrystallization by annealing flint: Green, H. W., 2d. 02682
Mechanism, recrystallization by annealing, flint: Wenk, H. R. 02683
Strength, Ottawa sand, shearing stress: Ko, Hon-Yim. 02711
Strength, yield, strain hardening, limestone: Cheatham, J. B., Jr. 02851
Triaxial stress, reduction in porosity and elasticity: Wilhelmi, Bernhard. 02838
Field studies
Slip-line orientations, Caledonides, Alps, Appalachians: Hansen, Edward. 02715
Theoretical studies
Elasticity, radiation from propagating phase boundary: Holstrom, Geoffrey Burwell. 02610
Plastic, dislocation theory, upper mantle: Young, Chapman, 3d. 02625
Viscoelasticity, stress propagation: Mercado, Edward John. 02575
Devonian
Alberta
Miette area, Cairn Formation, reef complex: Noble, James Peter Allison. 02616
Appalachians
Catskill red beds, genesis of coloration: Friend, P. F. 02783
Indiana
Southeastern, stratigraphy, conodont zones: Rexroad, Carl B. 02798
Maine
Greenville quadrangle, stratigraphy: Espenshade, G. H. 02763
Northwest Territories
Root River, stratigraphy, reefs: Brady, W. B. 02818
Pennsylvania
Eastern, Trimmers Rock Member of Fort Littleton Formation: Frakes, Lawrence A. 02882
Quebec
Invertebrata, Gaspe Sandstone and Limestone Groups: Boucot, A. J. 02808
Diagenesis
Dolomite
Texas, Edwards Limestone: Fisher, W. L. 02951
Marine sediments
Polychaete reworking, Massachusetts, Cape Cod area: Rhoads, Donald C. 02892
Red beds
Appalachians, Catskill type, cf. world localities: Friend, P. F. 02783
Skeletal carbonates
Experimental studies: Land, Lynton S. 02836
Diagenesis
Stylolites
Illinois, fluorspar district: Amstutz, G. C. 02820
Diamonds
Properties
Transparency to ultraviolet: Tolansky, S. 02671
Dikes
Mechanism
Atlantic Ocean, Mid-Atlantic Ridge: Matthews, D. H. 02581
Montana-Wyoming, Beartooth Mts.: Prinz, Martin. 02617
Swarm
Montana-Wyoming, Beartooth Mts.: Prinz, Martin. 02617
Dolomite
Pennsylvania
Dauphin County, potential: MacLachlan, David B. 02878
Earth
Elasticity
Free oscillations, spectra from aftershock sequence: Press, Frank. 02515
General
Models, computer programs for gross data: Backus, G. E. 02948
Morphology, evolution: King, Lester C. 02828
Textbook, introductory, high school: Earth Science Curriculum Project. 02743
Interior
Density models, seismic equation of state: Anderson, Don L. 02504
Physical properties, rocks, density-velocity relations at 10 kb: Knopoff, Leon. 02505
Stresses, vector analysis: Backus, George E. 02947
Motions
Rotation, Chandler wobble, polar shift, earthquake source: Mansinha, L. 02447
Origin
Chemical events on primitive Earth: Abelson, P. H. 02730
Chemical reactions in primitive atmosphere: Abelson, P. H. 02731
Prebiologic chemical reactions: Abelson, P. H. 02718
Earthquakes
Alaska
March 28, 1964, south-central,effects, transportation, utilities: Eckel, Edwin B. 02897
March 1964, Alaskan Railroad damage: McCulloch, David S. 02707
Effects
Chandler wobble and polar shift: Mansinha, L. 02447
Earth banks and soil layers, stability response: Idriss, Izzat Muhammad. 02580
Free oscillations, spectra from aftershock sequence: Press, Frank. 02515
Reservoir-dam interaction: Chopra, Anil K. 03003

Earthquakes
Elastic waves
Body waves, attenuation characteristic, power-law approximation: Strick, E. 02516
Deep focus zones, anomalous mantle structure: Oliver, Jack. 02442
P-waves, short period, amplitudes, 30°-102° distance range: Cleary, John. 02446
Engineering geology
Dams, failure, slope-stability analysis and design: Seed, H. Bolton. 02761
General
National Earthquake Information Center, services: Lander, James F. 02969
Hawaii
May 1963, Koae fault zone, western, swarm: Kinoshita, Willie T. 02587
Magnitude
Determination, methods, accuracy: Freedman, Helen W. 03006
Determination, regional and near-regional distances, United States: Evernden, J. F. 03002
Prediction
California, earthquake risk map: Lomnitz, C. 03010
Utah
Seismicity, 1850-1965: Cook, Kenneth L. 03004
Ecology
California
Lagoonal, Mugu Lagoon, paleoecological aspects: Warme, John Edward. 02623
Invertebrata
Marine, intertidal sands, California, Tomales Bay: Johnson, Ralph Gordon. 02987
Malacostraca
Subterranean fresh-water, amphipods, eastern U.S.: Holsinger, John R. 02829
Mexico
Volcanic, effects, xylem growth patterns: Eggler, Willis A. 02983
Oregon
Lacustrine, Crater Lake: Nelson, C. Hans. 02501
Economic geology
Methods
Ore reserve calculations, statistical and geometric: Hazen, Scott W., Jr. 02956
Practice
Emphasis: Mitcham, Thomas W. 02698
Education
Earth science
Materials, textbook, high school: Earth Science Curriculum Project. 02743
General
College and university enrollment: Henderson, Bonnie C. 02424
Materials
Textbook, evolution, college level: Volpe, E. Peter. 02930
Physical science
Materials, textbook, college, nonscience major: Booth, Verne H. 02754
Elastic properties
Garnet
Constants, pressure and temperature derivatives: Soga, Naohiro. 02506
Rocks
Density-velocity relations at 10 kb: Knopoff, Leon. 02505
Sandstone
Measurement, under triaxial stress: Wilhelmi, Bernhard. 02838
Viscoelastic material
Theory, stress-propagation: Mercado, Edward John. 02575
Electrical properties
Clays
Conductivity, dielectric constant, relation to structure: Arulanandan, Kandiah. 02556
Electron microscopy
Data
Opal, optical properties, California: Sanders, J. V. 02830
Engineering geology
Bibliography
Snow, ice, frozen ground, cold regions: U.S. Library of Congress. 02510
Clays
Electrical properties, structure: Arulanandan, Kandiah. 02556
Experimental studies, coupled flow phenomena, clay-water systems: Gray, Donald Harford. 02558
Ontario, New Liskeard area, varved, foundation performance: Raymond, Gerald P. 02746
Ontario, New Liskeard area, varved, foundation performance: Stermac, A. G. 02762
Dams
Failure due to earthquakes, slope-stability analysis and design: Seed, H. Bolton. 02761
New Hampshire, Otter Brook Dam, static and seismic response analysis: Finn, W. D. Liam. 02771
New Hampshire, Otter Brook, static and seismic response analysis: Nussbaum, Herbert. 02765
Seismic, static response, earth-fill, finite element analysis: Finn, W. D. Liam. 02771
Seismic static response, earth-fill, finite element analysis: Hillis, S. F. 02744
Seismic, static response, earth-fill, finite element analysis: Peterson, R. 02764
Water pressure during earthquakes: Chopra, Anil K. 03003
Earthquakes
Alaska, 1964, Alaskan Railroad, damage: McCulloch, David S. 02707
Alaska, south-central, effects, transportation, utilities: Eckel, Edwin B. 02897
Earth banks and soil layers, response evaluation: Idriss, Izzat Muhammad. 02580

Engineering geology
Experimental studies
Ottawa sand, shearing deformation: Ko, Hon-Yim. 02711
Sand and silt, dynamic strength: Lee, Kenneth L. 02709
Foundations
Alaska, Alaskan Railroad, earthquake damage, 1964: McCulloch, David S. 02707
California, central, Dos Amigos pumping plant, rebound: Bara, John P. 02708
Highways
Concrete aggregates, sand properties, attrition tests, correlation: Chamberlin, W. P. 02979
Landslides
California, control problem: Cleveland, George B. 02916
Materials, properties
Aggregate sand, attrition text: Tuthill, L. H. 02890
Aggregates, sand quality, attrition tests, correlation: Chamberlin, W. P. 02979
Concrete aggregates, sand attrition test: Davis, R. E. 02889
Massachusetts, Boston area, bedrock, kaolinization: Kaye, Clifford A. 02586
Ontario, New Liskeard area, varved clays: Raymond, Gerald P. 02746
Ontario, New Liskeard area, varved clays: Stermac, A. G. 02762
Rock mechanics
Experimental studies, limestone, strain hardening: Cheatham, J. B., Jr. 02851
Fracturing, hydraulic, rock properties: Haimson, Bezalel. 02833
Shorelines
Alaska, Barrow area: Hume, James D. 02680
Connecticut, Westport area, beach stabilization: Vesper, William H. 02511
Slope stability
Clays and clay shales, overconsolidated, progressive failure: Bjerrum, Laurits. 02710
Embankment soils, dynamic strength tests: Lee, Kenneth L. 02709
Strip-mined areas, control: May, Robert F. 02790
Soils
Automatic data processing, retrieval systems, descriptors: Am. Society of Civil Engineers. 02706
Deformation, tests, stress dilatance of feldspar: Lee, I. K. 02712
Dynamic strength, sand, silt, experimental tests: Lee, Kenneth L. 02709
Earth banks and layers, response to earthquakes: Idriss, Izzat Muhammad. 02580
Engineering properties, research problems: Mason, Harold. 02739
Pesticide adsorption, ground-water contamination: Eye, John David. 02627

Engineering geology
Soils
Pesticide adsorption, ground-water contamination: King, Paul Hamilton. 02600
Epeirogenesis
Cretaceous
Mexico, Coahuila, Comanche Series: Smith, Charles Isaac. 02619
Erosion
Beaches
Connecticut, Westport area, beach fill behavior: Vesper, William H. 02511
Experimental studies
Hawaii, Oahu, soils, erodibility indices: Yamamoto, Teruo. 02801
Materials
Soils, forest watersheds, susceptibility, factors: Dyrness, C. T. 02789
Quebec
Montreal area, Mount Royal: Ritchot, Gilles. 02791
Slopes
Strip-mining disturbances, stabilization: May, Robert F. 02790
Wasting
Creep, rate, theoretical model: Kirkby, M. J. 02932
Estuaries
British Columbia
Strait of Georgia, Saanich Inlet, diatomaceous sediments, trace elements: Gross, M. Grant. 02899
New York
Hudson River, sediments: McCrone, Alistair W. 02488
Evaporites
Utah
Moab area, rare-earth borate nodules, genesis: Raup, Omer B. 02467
Evolution
Angiosperms
Utah, Bonneville Basin, mimulus, Quaternary: Lindsay, Delbert W. 02990
Brachiopoda
Atrypidae, Ordovician-Silurian: Boucot, A. J. 02885
Concepts
Textbook, introductory, college level: Volpe, E. Peter. 02930
Food gathering techniques
Track and trail evidence: Seilacher, Adolf. 02688
Faults
En echelon
California, Hollister area, current activity: Rogers, Thomas H. 02998
General
Nevada, Connors Pass quadrangle: Drewes, Harald. 02766
Grabens
California, Death Valley area, surface expression: Pouquet, Jean. 02825
Texas, Big Bend National Park: Maxwell, Ross A. 02913

Faults
Grabens
Washington, Ferry County, Republic graben: Muessig, Siegfried. 02436
High-angle
Arizona, Shylock fault zone: Anderson, C. A. 02470
Horst
New Mexico, Burro Mountains, Tyrone–Burro Peak block: Gillerman, Elliot. 02697
Mechanism
Alaska, Gulf of Alaska, wrench system: Stoneley, R. 02782
California, Palmdale area, San Andreas fault zone: Evans, James George. 02565
Overthrust
North Carolina, Grandfather Mtn. window, metamorphism: Bryant, Bruce. 02463
Patterns
Texas, Big Bend National Park: Maxwell, Ross A. 02913
Strike-slip
Alaska, regional trends, evolution, bending: Grantz, Arthur. 02607
Arizona, Shylock fault zone: Anderson, C. A. 02470
California, San Andreas, piezomagnetic changes preceding creep: Breiner, Sheldon. 02945
Systems
Atlantic Ocean, Mid-Atlantic Ridge, Vema Fracture zone: vanAndel, Tjeerd H. 02840
Texas, Big Bend National Park: Maxwell, Ross A. 02913
Florida
Geomorphology
Central Highlands, shorelines, former lake levels: Knochenmus, Darwin D. 02596
Hydrogeology
Alafia and Peace River basins, ground-water contamination, fluoride: Toler, L. G. 03001
Sedimentary petrology
Card Sound, carbonate sediments: Earley, Charles F. 02966
Central Highlands, beach ridge materials, grain size: Knochenmus, Darwin D. 02596
Southern tip, Miami Limestone, facies, genesis, Bahama Banks counterpart: Hoffmeister, J. Edward. 02512
Fluorspar
Illinois
Cave-in-Rock, occurrence: Brecke, E. A. 02691
Southern, relation to stylolites, diagenetic: Amstutz, G. C. 02820
Folds
Anticlines
Texas, Big Bend National Park: Maxwell, Ross A. 02913
Geometry
Slip-line orientations, analysis method: Hansen, Edward. 02737
Major
Texas, Big Bend National Park: Maxwell, Ross A. 02913
Folds
Minor
Texas, Big Bend National Park: Maxwell, Ross A. 02913
Superposed
Idaho, Boundary County, paragneiss on Kaniksu batholith: Nevin, Andrew Emmet. 02572
Foraminifera
Abathomphalidae, n.fam.
Cretaceous: Pessagno, Emile A., Jr. 02760
Cretaceous
California, Upper zones, Sacramento Valley, planktonic species: Douglas, Robert Guy. 02604
Gulf Coastal Plain, Upper, western, planktonic: Pessagno, Emile A., Jr. 02760
Fusulinidae
Permian, California, Calaveras Formation: Douglass, Raymond C. 02770
Globorotalia
Morphology, test, thickening, depth of occurrence: Orr, W. N. 02686
Marginotruncanidae, n.fam.
Cretaceous: Pessagno, Emile A., Jr. 02760
Misellina
Permian, California, Calaveras Formation: Douglass, Raymond C. 02770
Nagatoella
Permian, California, Calaveras Formation: Douglass, Raymond C. 02770
Parafusulina
Permian, California, Calaveras Formation: Douglass, Raymond C. 02770
Schubertella
Permian, California, Calaveras Formation: Douglass, Raymond C. 02770
Tertiary
Alabama, Nanafalia Formation, *Ostrea thirsae* beds: Smith, Charles Culberson. 02875
North and South Carolina, Duplin and Waccamaw Formations, assemblages: Howard, James Franklin. 02611
Fossils, problematic
Nomenclature
Binomial proliferation protest: Branson, Carl C. 02904
Gas, natural
California
Edison field, Main area, occurrence: Barnes, J. A. 02940
Shale Flats field, Mabury sandstone: Anderson, David N. 02939
Shale Point field, Mabury sandstone: Anderson, David N. 02938
Willows-Beehive Bend field, occurrence: Barger, R. M. 02937
Exploration
Methods, sediments, directional, scalar properties: McDaniel, Gary A. 03016
Geochemistry
General, symposium: Nagy, Bartholemew. 02772

Gas, natural
Illinois
Production zones, maps: Howard, Richard H. 02679
Kentucky
Prestonsburg quadrangle, resources: Rice, Charles L. 02721
Williamsburg quadrangle, resources: Tabor, Rowland W. 02724
Oklahoma
Woods County, Oakdale field, Red Fork sands, occurrence, resources: Thalman, A. L. 02934
Pennsylvania
California quadrangle, resources: Schweinfurth, Stanley P. 02722
Production
Nuclear explosions, experiments: Mickey, W. V. 02849
Nuclear explosions, methods: Mickey, W. V. 02850

Gems
Opal
California, optical properties: Sanders, J. V. 02830

General
Philosophy
Emphasis: Mitcham, Thomas W. 02698
Geological hypotheses, changing ideas, oceanography: Shepard, F. P. 02877
Practice
Geological sciences, United States: Dunham, K. C. 02876
Hydrologic research, forest watershed relations, symposium: Sopper, William E. 02784
Symposium
Industrial mineral exploration and development: Kansas Geological Survey, 02963
Textbooks
Earth science, high school: Earth Science Curriculum Project, 02743
Laboratory manual, physical geology: Zumberge, James H. 02914
Physical science, college, nonscience major: Booth, Verne H. 02754
United States Geological Survey
Research, 1967: U.S. Geological Survey, 02598

Geochemical prospecting
Analytical techniques
Direct-reading spectrophotometer: Cruft, E. F. 02692
Gold
Analysis, atomic absorption: Beevers, J. R. 02699

Geochemical surveys
Alaska
Metals, Chugach Mountains, Metal Creek area: Richter, Donald H. 02898

Geochemistry
Chert aggregates
Ion exchange, variation of α-quartz parameters with heat: Wilband, John T. 02957
Electrochemical properties
Activity coefficients, emf measurement technique: Christ, C. L. 02477
Gas, natural
General, symposium: Nagy, Bartholemew, 02772
Ion exchange
Petroleum, porphyrins, metal complex reactions: Hodgson, G. W. 02774
Marine sediments
Diatomaceous, British Columbia, Saanich Inlet, trace elements: Gross, M. Grant. 02899
Petroleum
Asphaltic components, colloidal form: Witherspoon, P. A. 02775
General, symposium: Nagy, Bartholemew. 02772
Precambrian rocks
Organic materials, criteria, methods for study: Hoering, T. C. 02734
Processes
Liquid immiscibility, apatite rocks: Philpotts, A. R. 02713
Petroleum, migration and accumulation, mechanism: Baker, E. G. 02776
Solubility
Petroleum in water, migration and accumulation mechanism: Baker, E. G. 02776
Quartz, 400°–500°C, 1 kb: Sommerfeld, R. A. 02441

Geochronology
Hydration of glass
Obsidian, archeologic sites, dating: Michels, Joseph W. 03007
Paleomagnetism
Clays, Arizona, Snaketown ruins, fire pits: Weaver, Kenneth F. 02675

Geologic barometry
Volcanics
Oxygen-rich, calibration need: Carmichael, I. S. E. 02444

Geologic thermometry
Pyroxene
Ontario, Sudbury area, Strathcona mine: Naldrett, A. J. 02640
Sulfides
Fe–Pb–S system, experimental: Brett, Robin. 02696
Nevada, Tem Piute: Buseck, Peter R. 02695

Geological exploration
Methods
Limestone-dolomite mapping, Ca–Mg ratio in ground water: Meisler, Harold. 02595
Oceanic, crust, acoustic systems, positioning and hole re-entry: Schneider, William P. 02976

Geomorphology
Eolian features
Dunes, California, Oceano coastal area: Matthews, Jerry Lee. 02613
Dunes, Colorado, Great Sand Dunes Natl. Monument: Johnson, Ross B. 02588
Fluvial features
Alluvial fans, Iowa, Dutton's Cave valley, West Union Talus unit: Hedges, James A. 02905
Alluvial fans, processes: Hook, Roger LeB. 02933
Entrenched meanders, Indiana, south-central: Powell, Richard L. 02797
Pediments, formation, sheet- and stream-floods: Rahn, Perry H. 02981
Rivers, meander wavelength: Schumann, S. A. 02684
Transport, sediment yield rate, Oklahoma, Washita River: Allen, P. B. 02800
Glacial features
California, Yosemite National Park, guidebook: Scharff, Robert. 02755
Cirques, Alaska, Yukon-Tanana upland: Pewe, Troy L. 02811
Deposits, drainage, Pennsylvania, Erie County: Tomikel, John C. 02747
Moraines, Oregon, Wallowa Lake area, compound: Crandell, Dwight R. 02486
Lacustrine features
Lake levels, former high, Florida, Central Highlands: Knochenmus, Darwin D. 02596
Landform description
Classification map, genetic legend, Quebec, Montreal area: Ritchot, Gilles. 02881
Indiana, south-central: Powell, Richard L. 02797
Manitoba, Tiger Hills region, glacial features, glacial lakes: Elson, John Albert. 02605
Northwest Territories, arctic area: Bird, J. Brian. 02929
Pennsylvania, Erie County: Tomikel, John C. 02747
Saskatchewan, Yorkton area: Cherry, John Anthony. 02561
Landform evolution
California, Death Valley area, tectonic effects: Pouquet, Jean. 02825
Northwest Territories, arctic area: Bird, J. Brian. 02929
Quebec, Montreal area, Mount Royal: Ritchot, Gilles. 02791
Texas, Big Bend National Park: Maxwell, Ross A. 02908
World, physical features, ocean basins: King, Lester C. 02828
Marine features
Terraces, wavecut, Alaska, Seward Peninsula, western: Sainsbury, C. L. 02456
Mass movements
Creep, rate, theoretical model: Kirkby, M. J. 02932
General, Greenland, Tasersiaq area: Everett, K. R. 02802

Geomorphology
Quantitative geomorphology
Drainage basins, Horton's Law of Stream Numbers: Smart, J. Samuel. 02799
Soils, erodibility indices, Hawaii, Oahu: Yamamoto, Teruo. 02801
Shore features
Beaches, erosion, Connecticut, Westport area: Vesper, William H. 02511
Transport, Alaska, Barrow area, 1948–63: Hume, James D. 02680
Solution features
Caves, Iowa, Dutton's Cave valley, retreatal gorge, vertical shaft: Hedges, James A. 02905
Caves, karst, Indiana, south-central: Powell, Richard L. 02797
Experimental studies, limestone, ground water: Howard, Alan D. 02816
Karst, caves, Puerto Rico, Rio Camuy Cave area: Thrailkill, John V. 02741
Volcanic features
Caves, Idaho, southern, Crystal Ice Caves: Papadakis, Jim. 02738
Geophysical methods
Objects
Petroleum, exploration, history, potential: Thralls, Hugh M. 03018
Geophysical surveys
Montana
Glasgow area, Bearpaw Shale properties, logging: Stearns, Ronald T. 02972
Georgia
Geomorphology
Shorelines, late Pleistocene, correlation with Africa: Hoyt, John H. 02814
Mineralogy
Clay minerals, Altamaha River watershed, basin sediments: Jinks, Douglas David. 02626
Weathering
Altamaha River watershed, granite, gneiss, amphibolite: Jinks, Douglas David. 02626
Geosynclines
Gulf of Alaska
Evolution, Mesozoic–Cenozoic sedimentary province: Stoneley, R. 02782
Germanium
Geochemistry
Distribution, metallic phases of iron meteorites: Goldstein, J. I. 02425
Geysers
Yellowstone National Park
Seismic and steam activity: Nicholls, Harry R. 02445
Glaciation
Correlation
Alberta, Rocky Mountain and Laurentide tills, chronologies: Wagner, William Philip. 02622
Deglaciation
Alberta, southwestern: Wagner, William Philip. 02622

Glaciers
Arctic
General, research review: Glaciology Panel. 02681
Wyoming
Teton Glacier, rate of movement, thickness, resurvey 1966: Reed, John C., Jr. 02487
Gold
Alaska
Chugach Mountains, Metal Creek area, exploration: Richter, Donald H. 02898
Analysis
Atomic absorption spectroscopy: Beevers, J. R. 02699
Atomic-absorption spectroscopy, sample preparation: Huffman, Claude, Jr. 02434
Colorado
Mount Wilson quadrangle, occurrence, production: Bromfield, Calvin S. 02810
Nevada
Eureka County, resources, production: Roberts, Ralph J. 02975
Mount Velma quadrangle, resources: Coash, John R. 02973
Properties
Reflectivity, silver alloys: Eales, Hugh V. 02693
Washington
Republic mining district, occurrence, production: Muessig, Siegfried. 02436
Granite
South Carolina
Fairfield County, southwestern, resources: Wagener, H. D. 02847
Gravel
Exploration
Infrared methods, Indiana: Carr, Donald D. 02946
Indiana
Central, exploration, infrared methods: Carr, Donald D. 02946
Properties
Concrete aggregates, sand attrition test: Davis, R. E. 02889
Gravity methods
Interpretation
Anomalies, batholiths, shape and mass distribution: Bott, M. H. P. 02491
Reduction method, topographic effect, computer application: Takin, M. 03009
Greenland
Areal geology
Eastern, early reconnaissance of L. R. Wager: Deer, W. A. 02780
Geomorphology
Tasersiaq area, mass wasting: Everett, K. R. 02802
Maps, geologic
Qagssimiut area: Ayrton, S. N. 02803
Mineralogy
Pyrrhotite–marcasite nodules, Ivigtut siderite–cryolite ore: Soen, Oen Ing. 02804
Greenland
Petrology
Qagssimiut area, Precambrian rocks: Ayrton, S. N. 02803
Ubekendt Ejland, Tertiary lavas, picritic intrusions: Drever, H. I. 02666
Western, anorthosites, metamorphic features: Windley, Brian F. 02943
Stratigraphy
Precambrian, Tertiary, cf. Baffin Island, Svartenhuk Peninsula: Clarke, D. B. 02667
Ground water
Alaska
Resources, Ocean Cape, development by infiltration gallery: Feulner, Alvin J. 02590
Arkansas
Resources, Jackson, Independence Counties: Albin, Donald R. 02827
California
Pumping effects on reservoirs, Pahrump Valley: Malmberg, Glenn T. 02745
Colorado
Resources, development, legal factors: Cornish, Earl. 02759
Florida
Contamination, Alafia and Peace River basins, fluoride: Toler, L. G. 03001
Illinois
Resources, Paducah (Ky.) area: Lambert, T. W. 02961
Kentucky
Resources, Milburn quadrangle: Davis, R. W. 02807
Resources, Paducah area: Lambert, T. W. 02961
Maryland
Movement, Potomac River, Point of Rocks area, base-flow study: Hanson, Ronald L. 02593
Massachusetts
Resources, Parker and Rowley River basins: Sammel, E. A. 02872
Michigan
Recharge, glacial drift, influence of forest cover: Urie, Dean H. 02787
Minnesota
Resources, northwestern, Two Rivers watershed: Maclay, R. W. 02920
Resources, Roseau River watershed: Winter, T. C. 02883
Nevada
Pumping effects on reservoirs, Pahrump Valley: Malmberg, Glenn T. 02745
Pennsylvania
Composition, Lancaster quadrangle, Ca–Mg ratio, correlation with source rocks: Meisler, Harold. 02595
Texas
Resources, Coleman County: Walker, Loyd E. 02756
Resources, Fayette County: Rogers, Lowell Thompson. 02748
Resources, Jasper and Newton Counties: Wesselman, J. B. 03000

Ground water
Texas
Resources, quality, Montague County: Bayha, David C. 02925
[illegible]mala
[illegible]nology
[illegible]main of volcanoes, general: Walker, G. P. L. 02778
Gulf Coastal Plain
Geochemistry
Salt-dome cap rock, carbon isotope composition: Cheney, E. S. 02716
Geophysical surveys
Onshore-offshore experiment, seismic, preliminary report: Hales, A. L. 02668
Paleontology
Foraminifera, Cretaceous, Upper, western, planktonic: Pessagno, Emile A., Jr. 02760
Gulf of Mexico
Mineralogy
Clay minerals, Sigsbee Deep, Quaternary sediments: Harlan, Ronald Wade. 02609
Paleontology
Foraminifera, Quaternary, *Globorotalia*, test-thickness: Orr, W. N. 02686
Sedimentary petrology
Sigsbee Deep, Quaternary sediments: Harlan, Ronald Wade. 02609
Structural geology
Gulf Coast geosyncline, seismic survey: Hales, A. L. 02668
Gymnosperms
Brachyphyllum(?) densum n.sp.
Permian, Texas, Arroyo Formation, new: Mamay, Sergius H. 02481
Permian
Texas, Arroyo Formation, affinities with Asia, Europe: Mamay, Sergius H. 02481
Gypsum
Indiana
Southwestern, resources: Rooney, Lawrence F. 02874
Haiti
Economic geology
Copper, Meme-Casseus district, occurrence, genesis: Kesler, Stephen Edward. 02612
Hawaii
Earthquakes
May 1963, Koae fault zone, western, swarm: Kinoshita, Willie T. 02587
Geomorphology
Hawaii Island, Kapoho, impact craters, cf. Moon: Hartmann, William K. 02985
Oahu, erosion, wildland soils, indices: Yamamoto, Teruo. 02801
Petrology
Kilauea, lavas, differentiation, experimental: Tilley, C. E. 02629
Kilauea Volcano, Makaopuhi lava lake, crystallization, olivine role: Moore, James G. 02980
Hawaii
Volcanology
Kilauea, summit deflation after May 1963 earthquakes: Kinoshita, Willie T. 02587
Heat flow
Crust
Continents and oceans, equality: Elsasser, Walter M. 02449
Measurement
Arizona, Ajo area: Bell, Peter M. 02689
Heavy minerals
Atlantic Ocean
Gulf of Maine, nearshore sediments, provenance: Ross, David A. 02473
New England
Northern coast, offshore sediments cf. rivers, provenance: Ross, David A. 02473
Rocky Mountains
Central, Tertiary rocks, assemblages: Sato, Yoshiaki. 02468
South Carolina
Resources, exploration: Williams, Lloyd. 02924
United States
High Plains, northern, Tertiary rocks, assemblages: Sato, Yoshiaki. 02468
History
Geological sciences
United States, surveys, training, research: Dunham, K. C. 02876
Petroleum
First oil well, Kentucky, Wayne County, 1818: Ireland, H. A. 02430
Hydrogeology
Applications
Petroleum exploration: Dickey, Parke A. 03027
Aquifer properties
Numerical methods, unsteady flow: Esmaili, Houshang. 02557
Current research
Forest watershed hydrology, symposium: Sopper, William E. 02784
Experimental studies
Ground-water movement, limestone solution: Howard, Alan D. 02816
Ground-water recharge, geologic interpretation: ElBoushi, Ismail Mudathir. 02563
Subsurface stormflow in residual soils, seepage rate, depth: Whipkey, Ronald Z. 02786
Geochemistry
Aluminum, stability, form, in natural water: Hem, J. D. 02826
Ground-water contamination
Pesticide movement through soils, adsorption tests: Eye, John David. 02627
Pesticide movement through soils, adsorption tests: King, Paul Hamilton. 02600
Ground-water movement
Bogs and peatlands, forested: Bay, Roger R. 02788

Hydrogeology
Mathematical models
Digital simulation, hydrologic cycle, Stanford Univ., Calif.: Crawford, Norman H. 02785
Resource development
Colorado, ground water: Cornish, Earl. 02759
System analogs
Digital simulation, hydrologic cycle, model, Stanford Univ., Calif.: Crawford, Norman H. 02785

Hydrothermal alteration
Zoning
New Mexico, Rio Arribo County, Precambrian banded iron deposits: McLeroy, Donald Frazier. 02614

Ice
Engineering properties
Bibliography: U.S. Library of Congress. 02510

Ice, nonglacial
Wisconsin
Saint Croix River, configuration, roughness: Carey, Kevin L. 02592

Idaho
Geomorphology
Southern, Crystal Ice Caves: Papadakis, Jim. 02738
Maps, geologic
Driggs quadrangle: Pampeyan, Earl H. 02896
Paleontology
Conodonts, Mississippian, Miligen Formation, Mackay area, correlation: Sandberg, Charles A. 02482
Stratigraphy
Cambrian–Quaternary, Driggs quadrangle, sections: Pampeyan, Earl H. 02896
Mississippian, Milligen Formation, relation to Lodgepole Limestone: Sandberg, Charles A. 02482
Structural geology
Boundary County, paragneiss on Kaniksu batholith, folds: Nevin, Andrew Emmet. 02572
Hawley Creek area, field analysis of macroscopic features: Lucchitta, Baerbel Koesters. 02569

Igneous rocks
Alkalic
Composition, Texas, Uvalde County, basaltic and nephelinitic types: Spencer, Alexander Burke. 02621
Melting, apatite rocks: Philpotts, A. R. 02713
Petrology, Maine, Greenville quadrangle: Espenshade, G. H. 02763
Andesite
Composition, Washington, Klickitat River canyon flow, K–rich: Sheppard, Richard A. 02469
Physical properties, magnetic, Quebec, Manicouagan structure: Larochelle, A. 02438
Anorthosite
Experimental studies, plagioclase equilibria at high pressures: Lindsley, D. H. 02656

Igneous rocks
Anorthosite
Petrology, Greenland, western, metamorphic features: Windley, Brian F. 02943
Basalt
Alteration, British Columbia, Karmutsen Group: Surdam, Ronald Clarence. 02544
Composition: Lovering, T. G. 02479
Composition, olivine, relation to crystallization history: Moore, James G. 02980
Differentiation, experimental studies: O'Hara, M. J. 02884
Flow direction, Washington, Yakima Basalt: Schmincke, Hans–Ulrich. 02942
General description, lava flows, Idaho, Snake River Lava Plain: Papadakis, Jim. 02738
Paleomagnetism, Washington, Yakima Basalt: Rietman, Jan David. 02618
Petrology, Northwest Territories, Baffin Island, cf. West Greenland: Clarke, D. B. 02667
Physical properties, magnetic, Quebec, Manicouagan structure: Larochelle, A. 02438
Carbonatite
Petrology, Ontario, Brent Crater, not meteor crater: Currie, K. L. 02793
Composition
New Mexico, Questa area, Tertiary: Ishihara, Shunso. 02970
Diabase
Geochemistry, analysis technique for, phosphorus, W–1: Greenland, L. Paul. 02484
Differentiation
Basalt, tholeiitic, role of olivine, Hawaii: Moore, James G. 02980
Experimental studies, tholeiitic and alkalic volcanic series: Tilley, C. E. 02629
Greenland, Ubekendt Ejland, Tertiary lavas, picritic intrusions: Drever, H. I. 02666
Texas, Uvalde County, Cretaceous alkalic intrusions: Spencer, Alexander Burke. 02621
General
General description, Texas, Big Bend National Park: Lonsdale, John T. 02912
General description, Texas, Big Bend National Park: Maxwell, Ross A. 02910
Granite
Composition, textures, Northwest Territories, Basler Eau Claire complex: Smith, Peter Henderson. 02620
Geochemistry, analysis technique for, phosphorus, G–1: Greenland, L. Paul. 02484
Granitic
Petrology, Maine, Greenville quadrangle: Espenshade, G. H. 02763
Granitization
Greenland, Qagssimiut area: Ayrton, S. N. 02803
Spilite suite
Mineral assemblages: Yoder, H. S., Jr. 02652

Igneous rocks
Volcanic ash
Petrology, Washington, Willapa submarine canyon, Mazama origin: Royse, Chester F., Jr. 02757
Volcanics
Composition, Wyoming, Leucite Hills, wyomingite, orendite, madupite: Carmichael, Ian S. E. 02664
Geochemistry, ferric–ferrous equilibria, controls: Carmichael, I. S. E. 02444
Geochemistry, melting relations, experimental studies: Tilley, C. E. 02629
Petrology, Greenland, Ubekendt Ejland, Tertiary lavas: Drever, H. I. 02666
Physical properties, magnetic, geochemical controls: Carmichael, I. S. E. 02444

Illinois
Economic geology
Fluorspar, southern, relation to stylolites, diagenetic: Amstutz, G. C. 02820
Petroleum, natural gas, production, maps: Howard, Richard H. 02679
Zinc, lead, Cave-in-Rock, occurrence: Brecke, E. A. 02691
Hydrogeology
Paducah (Ky.) area, aquifers: Lambert, T. W. 02961
Maps, ground water
Paducah (Ky.) area: Lambert, T. W. 02961
Maps, oil and gas
Production zones: Howard, Richard H. 02679
Mineralogy
Fluorite, sphalerite, southern, paragenesis: Amstutz, G. C. 02820
Stratigraphy
Pennsylvanian–Ordovician, sections: Howard, Richard H. 02679

Indiana
Areal geology
Southern, field trips, guidebook: Geological Society of America. 02805
Economic geology
Gravel, central, exploration, infrared methods: Carr, Donald D. 02946
Limestone, gypsum, coal, southwestern, resources: Rooney, Lawrence F. 02874
Limestone, properties, evaluation: West, Terry R. 02965
Geomorphology
South-central, karst, entrenched streams: Powell, Richard L. 02797
Glacial geology
West-central, glacial features: Schneider, Allan F. 02880
Paleontology
Conodonts, Silurian–Devonian, southeastern, zones: Rexroad, Carl B. 02798
Stratigraphy
Mississippian–Pennsylvanian, southwestern: Rooney, Lawrence F. 02874
Pleistocene, west-central: Schneider, Allan F. 02880
Silurian–Devonian, southeastern, correlation: Rexroad, Carl B. 02798

Industrial minerals
Exploration
Nonmetallic sedimentary deposits, geometry: Bates, Robert L. 02950
General
Forum symposium, University of Kansas: Kansas Geological Survey. 02963
Missouri
Resources, nonmetallic, potential: Martin, James A. 02960
Occurrence
Nonmetallic sedimentary deposits, geometry: Bates, Robert L. 02950
Production
Environmental and management pitfalls, role of geologist: DuCharme, Paul J. 02955
Properties
Pozzolanic materials, natural sources, potential testing, United States: Everett, Floyd D. 02959

Infrared methods
Interpretation
Soil temperatures, sand and gravel exploration: Carr, Donald D. 02946

Intrusions
Pipes
Utah, Cherry Creek area, breccia: Morris, Hal T. 02471
Plutons
Arizona, Colorado, Cornelia stock cf. Boulder batholith: Wadsworth, William Bingham. 02578
Sills
Quebec, Manicouagan structure, paleomagnetism: Larochelle, A. 02438
Structure
Rhode Island, Chepachet quadrangle: Quinn, Alonzo W. 02769
Texas, Big Bend National Park: Lonsdale, John T. 02912
Texas, Big Bend National Park: Maxwell, Ross A. 02908

Invertebrata
Devonian
Quebec, Gaspe Sandstone and Limestone, zonation: Boucot, A. J. 02808
Quaternary
Recent, California, Tomales Bay, ecology: Johnson, Ralph Gordon. 02987

Iowa
Geomorphology
Dutton's Cave, stream valley, retreatal gorge: Hedges, James A. 02905

Iron
Analysis
Atomic absorption spectroscopy: Abbey, Sydney. 02817
New Mexico
Rio Arriba County, Precambrian banded deposits, genesis: McLeroy, Donald Frazier. 02614

Isotopes
Carbon
Atmosphere, C-14, decay of excess from nuclear event: Plesset, Milton. 02507
Biogenic carbonates: Weber, Jon N. 02727
Fractionation, C-O-H gas-aqueous system: Deuser, W. G. 02663
Salt-dome cap rock, C-13 data, correction: Cheney, E. S. 02716

Kansas
Economic geology
Brines, oil fields, concentrated salts, possibilities: Angino, Ernest E. 02954
Construction materials, exploration, airphoto interpretation: Stallard, Alvis H. 02964
Limestone, eastern, Oread Limestone members: Galle, O. Karmie. 02953
Mineral resources, unit regional value concept: Griffiths, John C. 03017
Petroleum, Abilene-Nemaha anticline, possibilities: Brown, Donald M. 03030
Petroleum, central, possibilities: Mueller, George N. 03026
Petroleum, Sedgwick embayment, occurrence, production: King, Charles R. 03020
Petroleum, southwestern, Chester sandstones, resources: Marden, D. W. 03025
Geochemistry
Eastern, Pennsylvanian, Oread Limestone, analyses: Galle, O. Karmie. 02953
Stratigraphy
Mississippian, Chester sandstones, southwestern: Marden, D. W. 03025
Mississippian, western, correlation: Goebel, Edwin D. 03023
Pennsylvanian, Cherokee sand, central: Mueller, George N. 03026

Kentucky
Economic geology
Coal, natural gas, Prestonsburg quadrangle: Rice, Charles L. 02721
Coal, petroleum, natural gas, Williamsburg quadrangle: Tabor, Rowland W. 02724
Limestone, Appalachian region, resources: McGrain, Preston. 02750
Petroleum, Wayne County, first well in North America: Ireland, H. A. 02430
Zinc, lead, fluorspar district, occurrence: Brecke, E. A. 02691
Hydrogeology
Milburn quadrangle, Eocene aquifers: Davis, R. W. 02807
Paducah area, aquifers: Lambert, T. W. 02961
Maps, geologic
Prestonsburg quadrangle: Rice, Charles L. 02721
Williamsburg quadrangle: Tabor, Rowland W. 02724
Maps, ground water
Milburn quadrangle: Davis, R. W. 02807
Paducah area: Lambert, T. W. 02961
Paleontology
Brachiopoda, Ordovician, Middle, new species: Neuman, Robert B. 02767

Kentucky
Stratigraphy
Ordovician, Lexington Limestone: Neuman, Robert B. 02767
Ordovician-Pennsylvanian, Appalachian region, section: McGrain, Preston. 02750
Pennsylvanian, No. 4 (Dawson Springs No. 6) coal bed, correlation: Kehn, T. M. 02585
Pennsylvanian, Quaternary, Prestonsburg quadrangle, section: Rice, Charles L. 02721
Pennsylvanian, Quaternary, Williamsburg quadrangle, section: Tabor, Rowland W. 02724

Labrador
Engineering geology
Hydroelectric project, Churchill Falls area: Rivard, L. A. 02927

Lakes
Sediments
Oregon, Crater Lake: Nelson, C. Hans. 02501

Lakes, extinct
Alberta
Southwestern, Lake Lethbridge and other proglacial lakes: Wagner, William Philip. 02622

Lead
Genesis
Carbonate deposits, precipitation, cf. petroleum: Davidson, C. F. 02903
Illinois
Cave-in-Rock, occurrence: Brecke, E. A. 02691
Nevada
Eureka County, resources, production: Roberts, Ralph J. 02975
Rowland quadrangle, resources: Bushnell, Kent. 02886
Ontario
Bruce Peninsula, Niagara escarpment, occurrence: Guillet, G. R. 02906

Limestone
Indiana
Mississippian, properties, evaluation: West, Terry R. 02965
Southwestern, resources: Rooney, Lawrence F. 02874
Kansas
Eastern, Oread Limestone members, analyses: Galle, O. Karmie. 02953
Kentucky
Appalachian region, resources: McGrain, Preston. 02750
Pennsylvania
Dauphin County, potential: MacLachlan, David B. 02878

Lithium
Analysis
Atomic absorption spectroscopy: Abbey, Sydney. 02817

Magmas
Basalt
Composition, olivine, relation to crystallization history: Moore, James G. 02980

Magmas
Differentiation
Basalt, tholeiitic, role of olivine, Hawaii: Moore, James G. 02980
Haiti, Terre-Neuve quartz monzonite: Kesler, Stephen Edward. 02612
Texas, Uvalde County, Cretaceous basaltic and nephelinitic intrusions: Spencer, Alexander Burke. 02621
Experimental studies
Basalt, fractionation at 30 kb: O'Hara, M. J. 02884
Liquid immiscibility, apatite rocks: Philpotts, A. R. 02713
Magnesium
Analysis
Atomic absorption spectroscopy: Abbey, Sydney. 02817
Magnetic field, Earth
Secular variations
Relation to surface flow in core: Kahle, Anne B. 02991
Relation to surface flow in core: Vestine, E. H. 02992
Magnetic properties
Igneous rocks
Measurement, spinner magnetometer: Doell, R. R. 02521
Instruments
Magnetometer, automatic 3-magnet: Larochelle, A. 02923
Measurements
Anisotropy, technique: Cox, Allan. 02540
California, San Andreas fault, stress-induced changes: Breiner, Sheldon. 02945
Curie points, fluxgate magnetometers: Weijts, A. G. L. M. 02538
Magnetic phases, low-temperature analysis technique: Fuller, M. D. 02869
Magnetic susceptibility anisotropy, technique: Graham, John W. 02518
Nova Scotia, Prince Edward Island: Larochelle, A. 02809
Stable magnetization, a.c. demagnetization, analysis: Doell, Richard R. 02535
Stress-induced magnetization, 2-component magnetometer: Hodych, J. P. 02813
Tourmaline: Donnay, Gabrielle. 02650
Volcanic rocks
Geochemical controls: Carmichael, I. S. E. 02444
Magnetic surveys
Atlantic Ocean
Mid-Atlantic Ridge at 45° N., anomaly pattern analysis: Matthews, D. H. 02581
Mid-Atlantic Ridge near 27° N., sea-floor spreading evidence: Phillips, J. D. 02665
Maine
Absolute age
Greenville quadrangle, Moxie pluton, Shirley-Blanchard stock: Espenshade, G. H. 02763
Areal geology
Greenville quadrangle: Espenshade, G. H. 02763
Maine
Maps, geologic
Greenville quadrangle: Espenshade, G. H. 02763
Preliminary: Hussey, Arthur M. 02918
Major-element analyses
Basalt
Hawaii, Makaopuhi lava lake tholeiite: Moore, James G. 02980
Spectrographic data: Lovering, T. G. 02479
Bentonite
Missouri, Lamotte Formation: Beall, Arthur O., Jr. 02863
Celadonite
Nevada, Reno area: Foser, Margaret D. 02464
Diorite
Quebec, Ivry: Philpotts, A. R. 02713
Dolomite
Ohio, chemical and spectrochemical: Ingamells, C. O. 02494
Ground water
Minnesota, northwestern, Two Rivers watershed: Maclay, R. W. 02920
Texas, Coleman County: Walker, Loyd E. 02756
Texas, Jasper and Newton Counties: Wesselman, J. B. 03000
Texas, Montague County: Bayha, David C. 02925
Grunerite: Klein, Cornelis, Jr. 02891
Igneous rocks
Nevada, Schell Creek Range, Egan Range: Drewes, Harald. 02766
New Mexico, Questa area: Ishihara, Shunso. 02970
Limestone
Kansas, eastern, Oread Limestone members: Galle, O. Karmie. 02953
Ohio, chemical and spectrochemical: Ingamells, C. O. 02494
Mafic rocks
Maine, Greenville quadrangle: Espenshade, G. H. 02763
Olivine
Hawaii, Makaopuhi lava lake tholeiite: Moore, James G. 02980
Pyroxene
California, omphacite: Essene, E. J. 02673
Sedimentary rocks
Nevada, Taylor mining district: Drewes, Harald. 02766
Shale
Idaho-Wyoming, Meade Peak phosphatic: Pampeyan, Earl H. 02896
Volcanic rocks
Wyoming, Leucite Hills, wyomingite, orendite, madupite: Carmichael, Ian S. E. 02664
Malacostraca
Stygonectes
Recent, United States, eastern, subterranean: Holsinger, John R. 02829

Mammalia
Cenozoic
Marine forms, migrations, possible transarctic: Scheffer, Victor B. 02422
Geographic distribution
Cenozoic, marine forms, transarctic: Scheffer, Victor B. 02422
Quaternary, Bering Sea area, dispersions, correlations: Repenning, Charles A. 02458
Soricidae, Cenozoic, Americas and Europe: Repenning, Charles A. 02432
Peromyscus
Tertiary, Oregon, diversity in late: Shotwell, J. Arnold. 02895
Peromyscus pagei, n.sp.
Tertiary, Oregon, late: Shotwell, J. Arnold. 02895
Peromyscus valensis, n.sp.
Tertiary, Oregon, late: Shotwell, J. Arnold. 02895
Quaternary
Alaska, pre-Wisconsin, list: Pewe, T. L. 02459
North America, migrations, Bering land bridge: Repenning, Charles A. 02458
North America, migrations, Bering land bridge: Vangengeim, E. A. 02421
North America, northern, Asian source: Flerow, C. C. 02460
Soricidae
Cenozoic, subfamilies, distribution in time and place: Repenning, Charles A. 02432
Tertiary
Texas, Big Bend National Park, teeth, systematic descriptions: Maxwell, Ross A. 02908
Texas, Paleocene–Eocene, Big Bend area, faunal assemblage: Wilson, John A. 02911
Man, fossil
Quaternary
Migrations, Bering land bridge: Muller-Beck, Hansjurgen. 02423
Pacific Ocean, Bering Sea area, migration and dispersal: Laughlin, W. S. 02450
Manganese
Montana
Philipsburg district, occurrence: Prinz, William C. 02822
Manitoba
Glacial geology
Tiger Hills region, Pleistocene fluctuations, glacial lakes: Elson, John Albert. 02605
Mantle
Deformation
Dislocation theory, experimental applications: Young, Chapman, 3d. 02625
Elastic waves
Compressional, attenuation, cf. shear waves: Kovach, Robert L. 03012
Compressional, attenuation, seismic energy absorption: Sarmah, Suryya Kanta. 02576
P-waves, diffracted at core boundary, interpretation: Phinney, Robert A. 03013
Mantle
Experimental studies
Mineral equilibria, temperature and pressure calculations: Ahrens, Thomas J. 02427
Low-velocity layer
Body-wave data, interpretation, automated technique: Archambeau, C. B. 03008
Mineralogy
Clinoenstatite, forsterite stability at 100–350 kb: Ahrens, Thomas J. 02427
Stresses
Vector analysis: Backus, George E. 02947
Structure
Anomalous, deep earthquake zones: Oliver, Jack. 02442
Boundary with core, P-waves, diffracted, interpretation: Phinney, Robert A. 03013
Inhomogeneities, velocity profile data: Toksoz, M. Nafi. 02503
Upper, phase transition regions, North America, western, depths: Anderson, Don L. 02670
Marine geology
Bottom features
Alaska, Gulf of Alaska, physiographic provinces: McManus, Dean A. 02758
Arctic Mid-Oceanic Ridge: Johnson, G. Leonard. 02792
Continental shelf, Atlantic, television system use: Eddy, J. E. 02472
Continental slope off New York, buried knoll and sediment drift: Lowrie, Allen, Jr. 02685
Pacific Ocean, Gulf of Alaska abyssal plains, seismic survey: Hamilton, Edwin L. 02439
Submarine canyons, turbidites, deltas, changing ideas: Shepard, F. P. 02877
Textbook: Shepard, Francis P. 02928
Topography, relation to sea-floor spreading rate: Menard, H. W. 02669
Instruments
Acoustic systems for positioning and hole re-entry: Schneider, William P. 02976
Seismic-reflection profiling, mineral placer exploration: Miller, H. J. 02977
Squeezer, sediment, water removal: Presley, Bob J. 02841
Television systems, continental shelf exploration: Eddy, J. E. 02472
Under-water vehicle, ocean-bottom surveying: Reidy, F. A. 02978
Sediments
Direct precipitation, carbonate: Fischer, Alfred G. 02931
Florida, Card Sound and continental shelf, characteristics: Earley, Charles F. 02966
Gulf of Mexico, Sigsbee Deep, Quaternary: Harlan, Ronald Wade. 02609
Massachusetts, Cape Cod area, biogenic reworking: Rhoads, Donald C. 02892
Slope off California, dolomite boulder: Pierce, J. W. 02835

Marine geology
Stratigraphy
Second layer, thickness related to sea-floor spreading rate: Menard, H. W. 02669
Structure
Atlantic Ocean, Mid-Atlantic Ridge, Vema Fracture offset: vanAndel, Tjeerd H. 02840
Ocean ridges, genesis: Wilson, J. Tuzo. 02777
Pacific Basin, islands, landforms: Thomas, William L., Jr. 02742
Maryland
Hydrogeology
Potomac River, Point of Rocks area, base-flow study: Hanson, Ronald L. 02593
Massachusetts
Areal geology
Springfield South quadrangle: Hartshorn, Joseph H. 02705
Engineering geology
Materials, properties, Boston area, bedrock, kaolinization: Kaye, Clifford A. 02586
Glacial geology
Springfield South quadrangle, features, history: Hartshorn, Joseph H. 02705
Hydrogeology
Parker and Rowley River basins, ground-water resources: Sammel, E. A. 02872
Maps, geologic
Parker and Rowley River basins, surficial: Sammel, E. A. 02872
Springfield South quadrangle: Hartshorn, Joseph H. 02705
Maps, ground water
Parker and Rowley River basins: Sammel, E. A. 02872
Sedimentary petrology
Boston area, kaolinization of bedrock: Kaye, Clifford A. 02586
Cape Cod area, marine sediments, biogenic reworking: Rhoads, Donald C. 02892
Stratigraphy
Triassic, Portland Arkose, Springfield South quadrangle: Hartshorn, Joseph H. 02705
Weathering
Boston area, kaolinization of bedrock: Kaye, Clifford A. 02586
Mercury
California
Wilbur Springs district, genesis: Moisseeff, Alexis Nicolas. 02615
Mesozoic
Alaska
Gulf of Alaska sedimentary province: Stoneley, R. 02782
Metals
New Mexico
Burro Mountains, occurrence, fault control: Gillerman, Elliot. 02697
Metamorphic rocks
General
Petrology, Maine, Greenville quadrangle: Espenshade, G. H. 02763
Petrology, structure, Colorado, Puma Hills: Wobus, Reinhard Arthur. 02579
Metamorphic rocks
General
Petrology, structure, Rhode Island, Chepachet quadrangle: Quinn, Alonzo W. 02769
Gneiss
Structural features, folds, Idaho, Boundary County: Nevin, Andrew Emmet. 02572
Mineral facies
California, Franciscan glaucophane schist, omphacite: Essene, E. J. 02673
Montana, Sheridan district, Precambrian rocks: Burger, Henry Robert, 3d. 02601
Serpentinite
Alteration, dehydration, bearing on deformation: Scarfe, C. M. 02674
Metamorphism
Contact
California, southeastern, zircon alteration: Gastil, R. Gordon. 02499
Skarn, Nevada, Tem Piute: Buseck, Peter R. 02695
P-T conditions
California, Franciscan glaucophane schist: Essene, E. J. 02673
Regional
California-Oregon, blueschist belt below thrust, upward increase: Blake, M. C., Jr. 02462
Experimental studies, kyanite barometer: Richardson, S. W. 02654
New Hampshire, Vermont, zircon alteration: Gastil, R. Gordon. 02499
North Carolina, Grandfather Mtn. window, oxidation: Bryant, Bruce. 02463
P-T conditions, zoning, New York, Adirondack Mts.: deWaard, D. 02984
Retrograde
North Carolina, Grandfather Mtn. window, oxidation: Bryant, Bruce. 02463
Zoning
Pelitic rocks, effect of variable oxygen activity: Fisher, G. W. 02651
Meteor craters
Ontario
Brent, origin questioned: Currie, K. L. 02793
Meteorites
Composition
Irons, Ge distribution in metallic phases: Goldstein, J. I. 02425
Volatile elements, abundances, chemical fractionation: Larimer, John W. 02490
Cosmic dust
Barbados: Parkin, D. W. 02502
Estherville
Rare-gas chronology: Megrue, G. H. 02443
Genesis
Condensation history, fractionation pattern: Larimer, John W. 02493

Meteorites
Iron
Inclusions, troilite, occurrence and origin: Brett, Robin. 02907
Shergotty
Rare-gas chronology, correction: Megrue, G. H. 02443
Mexico
Areal geology
Chiapas, Teopisca Comitan area: Alvarado Ortuno, Jorge E. 02796
Economic geology
Lead-silver, Chihuahua, Frisco mine, evaluation: Link, Richard F. 02702
Salt, domes, Gulf coast region: Halbouty, Michel T. 02894
Geomorphology
Yucatan, Alacran Reef, sand cays, types: Folk, Robert L. 02848
Mineralogy
Durangite, crystal structure: Fabregat Guinchard, Francisco J. 02873
Paleontology
Foraminifera, Cretaceous, Upper, Coastal Plain, planktonic: Pessagno, Emile A., Jr. 02760
Petrology
Paricutin, lavas, differentiation, experimental: Tilley, C. E. 02629
Sedimentary petrology
Yucatan, Alacran Reef, sand cays: Folk, Robert L. 02848
Stratigraphy
Cretaceous, Coahuila and Comanche Series, northern Coahuila: Smith, Charles Isaac. 02619
Structural geology
Gulf coast region, salt tectonics: Halbouty, Michel T. 02894
Volcanology
Mexico City area, chain of volcanoes, general: Walker, G. P. L. 02778
Paricutin Volcano, effects, xylem growth patterns: Eggler, Willis A. 02983
Weathering
Tabasco, coastal piedmont, red bed genesis: Walker, Theodore R. 02492
Michigan
Hydrogeology
Glacial drift areas, ground-water recharge, influence of forest cover: Urie, Dean H. 02787
Micropaleontology
Tertiary
North and South Carolina, Duplin and Waccamaw Formations: Howard, James Franklin. 02611
Mineragraphy
Reflectivity
Gold-silver alloys: Eales, Hugh V. 02693
Mineral data
Acmite
Melting relations at high pressures: Gilbert, Charles M. 02662
Mineral data
Aluminum
Geochemistry, sulfatization, kinetics: Chao, Tze. 02577
Amphibole
Composition, properties, glaucophane-riebeckite: Borg, I. Y. 02672
Anorthite
Heat of formation: Sommerfeld, R. A. 02893
Ardennite
Structure, refinement: Donnay, Gabrielle. 02649
Barite
Nevada, Nye County, general description: Shawe, D. R. 02433
Biotite
Properties, interstratification, ion exchange equilibrations: Rhoades, James David. 02545
Celadonite
Nevada, Reno area, analyses, atomic ratios: Foster, Margaret D. 02464
Clinoenstatite
Stability at 100–350 kb: Ahrens, Thomas J. 02427
Clinoptilolite
Occurrence in bentonite, Colville Group, Alaska: Reynolds, R. C., Jr. 02861
Cristobalite
Occurrence in bentonite, Colville Group, Alaska: Reynolds, R. C., Jr. 02861
Cummingtonite-grunerite series
Composition, lattice parameters: Klein, Cornelis, Jr. 02891
Diamond
Type II, abundance: Tolansky, S. 02671
Durangite
Structure, Mexico: Fabregat Guinchard, Francisco J. 02873
Fayalite
Melting curve, up to 40 kb: Hsu, L. C. 02440
Pressure-temperature relations: Lindsley, D. H. 02659
Feldspar
Potassium, melting relations to 40 kb: Lindsley, D. H. 02653
Ferrosilite
Crystal structure refinements: Burnham, Charles W. 02636
Pressure-temperature relations: Lindsley, D. H. 02659
Forsterite
Phase relations with albite-anorthite: Schairer, J. F. 02657
Stability at 100–350 kb: Ahrens, Thomas J. 02427
Garnet
Elastic constants, pressure and temperature derivatives: Soga, Naohiro. 02506
Synthetic, phase equilibria: Hsu, Liang-chi. 02567
Grunerite
Composition, lattice parameters: Klein, Cornelis, Jr. 02891

Mineral data

Hydroxyapatite
Structure: Skinner, C. 02648

Kyanite
Pressure–temperature relations with sillimanite: Richardson, S. W. 02654

Leucite
Melting relations, at high pressures: Lindsley, D. H. 02653

Madupite
Wyoming, Leucite Hills: Carmichael, Ian S. E. 02664

Manganese
Structure, dendrites, 2 dimensional, genesis: Finney, V. L. 02846

Melilite
Synthetic, high temperature behavior: Schairer, J. F. 02714

Mica
Tetrasilicic dioctahedral, analyses and atomic ratios: Foster, Margaret D. 02464

Muscovite
Heat of formation: Sommerfeld, R. A. 02893
Polymorphism of 3T and $2M_1$ types: Guven, Necip. 02637

Olivine
Solid solution series, application, iron–formation genesis: Fisher, G. W. 02658

Omphacite
Pressure of formation, indicator: Bell, Peter M. 02661

Opal
Structure, properties, California: Sanders, J. V. 02830

Orendite
Wyoming, Leucite Hills: Carmichael, Ian S. E. 02664

Pentlandite
Composition at 600°C: Craig, J. R. 02643
Formation by exsolution: Naldrett, A. J. 02641
Temperature of formation, maximum: Craig, J. R. 02646

Plagioclase
Melting relations, high pressures: Lindsley, D. H. 02656
Phase relations, 1 atmosphere: Schairer, J. F. 02657

Pyrite
Temperature of formation, maximum: Craig, J. R. 02646

Pyroxene
Composition, Ontario, Strathcona mine: Naldrett, A. J. 02640
Melting relations at 40 kb, jadeite–diopside: Bell, Peter M. 02661
Phase equilibria, Ca–Al–Si–O: Hays, James Fred. 02660
Phase relations, hedenbergite–ferrosilite join: Lindsley, D. H. 02719

Quartz
Deformation, preferred orientation produced by annealing: Green, H. W., 2d. 02682

Mineral data

Quartz
Deformation, preferred orientation produced by annealing: Wenk, H. R. 02683
High–low inversion, up to 35 kb: Cohen, Lewis H. 02426
Solubility, 400°–500°C, 1 kb: Sommerfeld, R. A. 02441

Rhodizite
Formula, structure, modified by ESR experiments: Donnay, Gabrielle. 02638

Serpentine
Geochemistry, equilibrium with buffered oxygen fugacities: Scarfe, C. M. 02674

Sillimanite
Composition, South Carolina: Redeker, Immo H. 02845

Staurolite
Stability to 10 kb: Richardson, S. W. 02655

Sulfur
Melting relations up to 20 kb by DTA methods: Bell, Peter M. 02728

Tourmaline
Magnetic properties: Donnay, Gabrielle. 02650
Structure, absolute orientation: Donnay, Gabrielle. 02647

Vaterite
Form birefringence, measurements: Donnay, J. D. H. 02639

Vermiculite
Properties, interstratification, ion exchange equilibrations: Rhoades, James David. 02545

Wustite
Pressure temperature relations: Lindsley, D. H. 02659

Wyomingite
Wyoming, Leucite Hills: Carmichael, Ian S. E. 02664

Zircon
Metamorphism, progressive effects: Gastil, R. Gordon. 02499

Zoisite
Heat of formation: Sommerfeld, R. A. 02893

Mineral deposits, genesis

Barite
California, Shasta County, Glidden Company deposit: Weber, F. Harold, Jr. 02968

Copper
Haiti, Meme–Casseus district: Kesler, Stephen Edward. 02612
North Carolina, Ore Knob mine: Kinkel, Arthur R., Jr. 02753

Experimental studies
Cu–Fe–Ni–S system, 550°–650°C: Craig, J. R. 02645
Cu–Pb–S ores: Craig, J. R. 02633
Fe–S–O–H system, 200°–300°C: Kullerud, G. 02635
Iron–nickel sulfide, fugacity of S, 600°C: Naldrett, A. J. 02642
Pentlandite composition, 600°C: Craig, J. R. 02643

Mineral deposits, genesis
Experimental studies
Pentlandite, formation by exsolution: Naldrett, A. J. 02641
Pyrite–molybdenite solid solution limits: Kullerud, G. 02631
Pyrite–pentlandite, maximum temperature of formation: Craig, J. R. 02646
Pyrrhotite–rich Ni–Cu ores, phases during cooling, Ontario: Craig, J. R. 02644
Sulfide assemblages, stability limits: Craig, J. R. 02634
Sulfur–oxide assemblages, stability limits: Kullerud, G. 02729
Tin–tungsten–molybdenum ores, Bi–Mo–S system: Stemprok, M. 02632
Igneous processes
Apatite rocks: Philpotts, A. R. 02713
Iron
New Mexico, Rio Arribo County, Precambrian banded deposits: McLeroy, Donald Frazier. 02614
Iron formation, metamorphosed
Experimental studies, olivine solid solution series, application: Fisher, G. W. 02658
Lead
Ontario, Bruce Peninsula, Niagara escarpment: Guillet, G. R. 02906
Lead–zinc
Illinois, Kentucky: Brecke, E. A. 02691
Northwest Territories, Pine Point orebodies, Mississippi Valley type: Davidson, C. F. 02903
Marine evaporites
Utah, Moab area, rare–earth borate nodules: Raup, Omer B. 02467
Mercury
California, Wilbur Springs district, hydrothermal relations: Moisseeff, Alexis Nicolas. 02615
Molybdenum
New Mexico, Questa mine: Ishihara, Shunso. 02970
Nickel–copper
Ontario, Sudbury area, Strathcona mine, igneous processes: Naldrett, A. J. 02640
Ore–forming fluids
Metals, California: Skinner, Brian J. 02694
Polymetallic ores
Carbonate reservoirs, possibilities: Davidson, C. F. 02903
Structural controls
New Mexico, Burro Mountains, fault blocks: Gillerman, Elliot. 02697
Temperature
Skarn, Nevada, Tem Piute: Buseck, Peter R. 02695
Uranium
Colorado, Ralston Buttes district: Sheridan, Douglas M. 02768
Zinc
Ontario, Bruce Peninsula, Niagara escarpment: Guillet, G. R. 02906

Mineral economics
Brines
Concentrated salts, production, oil–field possibilities: Angino, Ernest E. 02954
Industrial minerals
Exploitation, environmental and management pitfalls: DuCharme, Paul J. 02955
Symposium, exploration and development: Kansas Geological Survey. 02963
Property evaluation
Unit regional value concept: Griffiths, John C. 03017
Mineral exploration
Geophysical methods
Marine environment, placer deposits, seismic devices: Miller, H. J. 02977
Ore guides
Canadian Shield, geochronologic provinces: Sarcia, Jacqueline. 02971
Non–metallics in sedimentary rock, geometry: Bates, Robert L. 02950
Programs
Canada, federal and provincial surveys, other organizations: Ogilvie, W. P. 02879
Integrated, geophysical, geological, geochemical, Nevada: Cavender, Wayne Sherrell. 02560
Minnesota, Duluth Gabbro Complex, disseminated sulfides: Sims, P. K. 02855
Mineral resources
Missouri
Possibilities, nonmetallic: Martin, James A. 02960
Production
Unit regional value concept, application in Kansas: Griffiths, John C. 03017
Mineral zoning
Skarn deposit
Nevada, Tem Piute: Buseck, Peter R. 02695
Sulfide
Illinois, Kentucky: Brecke, E. A. 02691
Mineralogy
Composition
Formula derivation from analyses, computer–based method: Jackson, Everett D. 02465
Experimental studies
Dendrites, 2–dimensional, genesis: Finney, V. L. 02846
Identification techniques
Infrared spectra, multiple–scan interferometer: Low, M. J. D. 02749
Mining geology
Evaluation
Assay data, discriminant analysis: Link, Richard F. 02702
Ore reserve calculations, geometric and statistical methods: Hazen, Scott W., Jr. 02956
Subsurface formations, physical properties, regression analysis: VonGonten, William Douglas. 02599
Methods
Statistical analysis, sampling, assay data: Hazen, Scott W., Jr. 02509

Mining geology
Production control
Industrial minerals, environmental and management pitfalls: DuCharme, Paul J. 02955
Technology
Orebody geometry, nonmetallics in sedimentary rock: Bates, Robert L. 02950
Minnesota
Economic geology
Copper, nickel, Duluth Gabbro Complex, sulfides, exploration: Sims, P. K. 02855
Geomorphology
Southeastern, caves, limestone and sandstone: Hogberg, R. K. 02751
Hydrogeology
Northern, bogs and peatlands, forested, ground-water movement: Bay, Roger R. 02788
Northwestern, Two Rivers watershed: Maclay, R. W. 02920
Roseau River watershed, water resources: Winter, T. C. 02883
Maps, ground water
Northwestern, Two Rivers watershed: Maclay, R. W. 02920
Roseau River watershed: Winter, T. C. 02883
Mineralogy
Clay minerals, Glenwood Formation, southeastern: Parham, Walter. 02865
Sedimentary petrology
Southeastern, Glenwood Formation, provenance: Parham, Walter. 02865
Minor-element analyses
Celadonite
Nevada, Reno area: Foster, Margaret D. 02464
Mississippian
Alabama
Northern, Chesterian rocks: Emerson, John Wilford. 02564
Idaho
Mackay area, conodonts, Milligen Formation: Sandberg, Charles A. 02482
Indiana
Southwestern, stratigraphy: Rooney, Lawrence F. 02874
Kansas
Southwestern, Chester sandstones: Marden, D. W. 03025
Western, stratigraphy, correlation: Goebel, Edwin D. 03023
Montana
Stratigraphy, boundary, upper: Maughan, Edwin K. 02431
Missouri
Economic geology
Industrial minerals, nonmetallic, potential: Martin, James A. 02960
Petroleum, western, resources, heavy oil: Anderson, K. H. 03022
Mineralogy
Clays, heavy minerals, Lamotte Formation, bentonite: Beall, Arthur O., Jr. 02863
Mohorovicic discontinuity
Mohole project
Instruments, acoustic systems, positioning and hole re-entry: Schneider, William P. 02976
Mollusca
Environmental analyses
Experimental studies, shell geochemistry: Mitterer, Richard Max. 02570
Geochemistry
Amino acid content, shell and extrapallial fluid: Hare, P. E. 02733
Geographic distribution
Transarctic marine migrations, Cenozoic: Durham, J. Wyatt. 02428
Mercenaria
Experimental studies, shell geochemistry: Mitterer, Richard Max. 02570
Oliva
Experimental studies, shell geochemistry: Mitterer, Richard Max. 02570
Quaternary
Alaska, Pleistocene, marine, stratigraphic distribution: Hopkins, David M. 02454
Molybdenum
New Mexico
Questa mine, occurrence: Ishihara, Shunso. 02970
Montana
Areal geology
Sheridan district: Burger, Henry Robert, 3d. 02601
Economic geology
Mineral resources, Philipsburg district: Prinz, William C. 02822
Geophysical surveys
Glasgow area, Bearpaw Shale properties, logging: Stearns, Ronald T. 02972
Maps, geologic
Big Snowy and Amsden Groups, paleo distribution: Maughan, Edwin K. 02431
Philipsburg district: Prinz, William C. 02822
Mineralogy
Manganese, silver, zinc, Philipsburg district: Prinz, William C. 02822
Petrology
Beartooth Mountains, mafic dike swarms: Prinz, Martin. 02617
Stratigraphy
Mississippian–Pennsylvanian, Big Snowy and Amsden Groups: Maughan, Edwin K. 02431
Structural geology
Beartooth Mountains, mafic dike swarms: Prinz, Martin. 02617
Hawley Creek area, field analysis of macroscopic features: Lucchitta, Baerbel Koesters. 02569
Nevada
Areal geology
East-central, Connors Pass quadrangle: Drewes, Harald. 02766
Eureka County: Roberts, Ralph J. 02975

Nevada
Areal geology
Mount Velma quadrangle: Coash, John R. 02973
Rowland quadrangle: Bushnell, Kent. 02886
Economic geology
Barite, East Northumberland Canyon: Shawe, D. R. 02433
Metals, Eureka County: Roberts, Ralph J. 02975
Metals, Tem Piute, occurrence: Buseck, Peter R. 02695
Mineral resources, exploration, integration of methods, Humboldt County: Cavender, Wayne Sherrell. 02560
Geochemistry
Steamboat Springs area, sulfuric acid production, bacteria in soil: Ehrlich, Garry G. 02478
Hydrogeology
Pahrump Valley, ground-water reservoirs, pumping effects: Malmberg, Glenn T. 02745
Maps, geologic
Eureka County: Roberts, Ralph J. 02975
Mount Velma quadrangle: Coash, John R. 02973
Pahrump Valley: Malmberg, Glenn T. 02745
Quartzite Mountain quadrangle: Rogers, C. L. 02555
Rowland quadrangle: Bushnell, Kent. 02886
Soldier Pass (Calif.) quadrangle: McKee, E. H. 02553
Winnemucca quadrangle: Gilluly, James. 02554
Maps, ground water
Pahrump Valley: Malmberg, Glenn T. 02745
Mineralogy
Celadonite, Reno area, analyses, atomic ratios: Foster, Margaret D. 02464
Paleomagnetism
Cenozoic, Lousetown Formation, Virginia City area, lava flows: Heinrichs, Donald Frederick. 02624
Paleontology
Fauna, Permian, Sunflower Formation, Mt. Velma quadrangle: Hoare, Richard D. 02974
Invertebrata, Permian–Triassic, Medicine Range, biostratigraphy: Collinson, James Waller. 02602
Sedimentary petrology
Independence Range, Carboniferous cherts, turbidites, volcanics: Fagan, John J. 02606
Stratigraphy
Cambrian–Quaternary, Winnemucca quadrangle, sections: Gilluly, James. 02554
Carboniferous, Schoonover group, Independence Range, lithofacies: Fagan, John J. 02606
Cenozoic, Quartzite Mountain quadrangle, sections: Rogers, C. L. 02555
Permian–Triassic, Tertiary, Medicine Range: Collinson, James Waller. 02602

New England
Geophysical surveys
Long Island Sound to Buzzards Bay, offshore seismic profile: Tagg, A. Richard. 02475
Mineralogy
Heavy minerals, offshore sediments cf. rivers: Ross, David A. 02473
Sedimentary petrology
Northern coast, offshore sediments cf. rivers, heavy mineral suites: Ross, David A. 02473
Sedimentation rate, pollen, lakes: Davis, Margaret B. 02500

New Hampshire
Engineering geology
Dams, Otter Brook, static and seismic response, analysis: Finn, W. D. Liam. 02771
Dams, Otter Brook, static and seismic response, analysis: Nussbaum, Herbert. 02765
Petrology
Regional metamorphic zones, zircon alteration: Gastil, R. Gordon. 02499

New Jersey
Economic geology
Rare earths, resources, northern: Williams, Roger L. 02703
Petrology
Coastal plain, Kirkwood Formation: Isphording, Wayne Carter. 02568
Southern, Pensauken Formation, interpretation: Bowman, James Floyd, 2d. 02559
Stratigraphy
Miocene, Kirkwood Formation, coastal plain: Isphording, Wayne Carter. 02568

New Mexico
Economic geology
Iron, Rio Arriba County, Precambrian banded deposits, genesis: McLeroy, Donald Frazier. 02614
Metals, Burro Mountains, occurrence: Gillerman, Elliot. 02697
Molybdenum, Questa mine: Ishihara, Shunso. 02970
Petrology
Questa area, metamorphic and igneous rocks: Ishihara, Shunso. 02970
Sedimentary petrology
Sacramento Mountains, Holder Formation, shelf and basin cycles: Wilson, James Lee. 02489
Stratigraphy
Pennsylvanian, Holder Formation, facies, southern: Wilson, James Lee. 02489
Structural geology
Burro Mountains, fault blocks: Gillerman, Elliot. 02697

New York
Economic geology
Construction materials, concrete aggregates, properties, evaluation: Cutcliffe, William E. 02949

New York
Glacial geology
Long Island, late Pleistocene environments: Newman, Walter S. 02573
Paleontology
Palynomorphs, Pleistocene, Long Island–Staten Island, zonation: Sirkin, Leslie A. 02574
Petrology
Adirondack Mountains, metamorphism, P–T conditions, zoning: deWaard, D. 02984
Staten Island, Pensauken Formation, interpretation: Bowman, James Floyd, 2d. 02559
Sedimentary petrology
Hudson River estuary, bottom sediments: McCrone, Alistair W. 02488
Stratigraphy
Cambrian, Potsdam Sandstone, Dekalb area: Bloomer, R. O. 02497
Cambrian, Potsdam Sandstone, Dekalb area: Brown, J. S. 02582
Pleistocene, late, Long Island–Staten Island, palynology: Sirkin, Leslie A. 02574
Pleistocene, late, paleoecology: Newman, Walter S. 02573
Precambrian, Grenville Series, Dekalb area: Bloomer, R. O. 02497
Precambrian, Grenville Series, Dekalb area, reinterpretation: Brown, J. S. 02582

Newfoundland
Absolute age
Holyrood granite, Rb–Sr dates, interpretation: Rose, E. R. 02900
Stratigraphy
Precambrian, southeastern, age span, interpretation: Rose, E. R. 02900

Nickel
Minnesota
Duluth Gabbro Complex, sulfides, exploration: Sims, P. K. 02855

North America
Economic geology
Phosphate, resources, production, occurrence: Service, A. L. 02700
Geomorphology
Landform evolution: King, Lester C. 02828
Paleoclimatology
Quaternary, Ogotoruk Creek–Cape Thompson area: Johnson, Albert W. 02420
Paleontology
Brachiopoda, Ordovician–Silurian, atrypids: Boucot, A. J. 02885
Flora, Neogene–Pleistocene, northwestern, distribution: Wolfe, Jack A. 02457
Flora, Quaternary, Ogotoruk Creek–Cape Thompson area, distribution, ecology: Johnson, Albert W. 02420
Mammalia, Cenozoic, Soricidae, subfamilies, distribution: Repenning, Charles A. 02432
Mammalia, Quaternary, dispersions, correlations: Repenning, Charles A. 02458

North America
Paleontology
Mammalia, Quaternary, migrations, Bering land bridge: Vangengeim, E. A. 02421
Mammalia, Quaternary, northern, Asian source: Flerow, C. C. 02460
Man, fossil, Quaternary, migrations, Bering land bridge: Muller-Beck, Hansjurgen. 02423
Pelecypoda, *Thyasira*, Western Interior: Kauffman, Erle G. 02988
Stratigraphy
Carboniferous, cyclothems, cyclic mechanism: Bott, M. P. H. 02779

North Carolina
Absolute age
Ore Knob mine, copper mineralization: Kinkel, Arthur R., Jr. 02753
Economic geology
Copper, Ore Knob mine, genesis: Kinkel, Arthur R., Jr. 02753
Maps, geologic
Northern, sulfide belt: Kinkel, Arthur R., Jr. 02753
Mineralogy
Muscovite, Grandfather Mtn. window, iron-rich, oxidation during metamorphism: Bryant, Bruce. 02463
Paleontology
Foraminifera, Ostracoda, Tertiary, Duplin and Waccamaw Formations, coastal plain: Howard, James Franklin. 02611
Petrology
Grandfather Mountain window, metamorphism, oxidation: Bryant, Bruce. 02463
Stratigraphy
Tertiary, Duplin and Waccamaw Formations, coastal plain: Howard, James Franklin. 02611

Northwest Territories
Economic geology
Lead–zinc, Pine Point area, genesis in carbonate reservoir: Davidson, C. F. 02903
Mineral resources, Mackenzie, southwestern, 1966: Findlay, D. C. 02819
Geomorphology
Arctic area, landform evolution: Bird, J. Brian. 02929
Maps, aeromagnetic
Franklin, Sheet 27 C/O4: Canada Geological Survey. 02902
Petrology
Baffin Island, Tertiary volcanics, order of crystallization: Clarke, D. B. 02667
Mackenzie, Basler–Eau Claire Granites: Smith, Peter Henderson. 02620
Sedimentary petrology
Melville Island, Bjorne Formation, trend analysis, paleocurrent: Agterberg, F. P. 02832
Stratigraphy
Cretaceous–Tertiary, Mackenzie: Mountjoy, E. W. 02508

Northwest Territories
Stratigraphy
Devonian, Middle, Root River, reefs: Brady, W. B. 02818
Structural geology
Mackenzie, intrusions, Basler–Eau Claire Granites: Smith, Peter Henderson. 02620
Nova Scotia
Paleomagnetism
Triassic, North Mountain Basalt: Larochelle, A. 02809
Sedimentary petrology
Meguma Group, paleocurrent and basin analysis: Campbell, F. H. A. 02823
Windsor Group, breccia filling cavities: Clifton, H. Edward. 02677
Nuclear explosions
Applications
Production, recovery, natural gas, experiments: Mickey, W. V. 02849
Seismology, oil gas recovery: Mickey, W. V. 02850
Seismic effects
Longshot experiment, elastic wave traveltimes: Carder, Dean S. 02997
Oceanography
Practice
Sea floor features, changing ideas on genesis: Shepard, F. P. 02877
Science
Contributions to geology, Florida cf. Bahama Banks: Hoffmeister, J. Edward. 02512
Textbooks
Marine geology, introduction: Shepard, Francis P. 02928
Ohio
Areal geology
Hocking Hills State Park: DeLong, Richard M. 02922
Economic geology
Construction materials, chert aggregate, properties: Kneller, William A. 02958
Mineral resources, South Bloomingville quadrangle: DeLong, Richard M. 02922
Mineral resources, Wayne County: Multer, H. Gray. 02921
Geochemistry
Woodville, Marble Cliff, and Spore, limestone, dolomite analyses: Ingamells, C. O. 02494
Maps, geologic
South Bloomingville quadrangle: DeLong, Richard M. 02922
Surficial: Goldthwait, Richard P. 02962
Wayne County: Multer, H. Gray. 02921
Stratigraphy
Carboniferous, Quaternary, South Bloomingville quadrangle, section: DeLong, Richard M. 02922
Carboniferous, Wayne County, section: Multer, H. Gray. 02921
Oil and gas fields
California
Castaic Junction oil field: Cordova, Simon. 02935
Edison field, Main area: Barnes, J. A. 02940
Long Beach oil field, Recreation Park area: Ingram, William L. 02936
Ojai oil field, North Sulphur Mtn. area: Mitchell, William Spencer. 02941
Shale Flats gas field: Anderson, David N. 02939
Shale Point gas field: Anderson, David N. 02938
Willows–Beehive Bend gas field: Barger, R. M. 02937
Oklahoma
Oakdale field, Red Fork sand: Thalman, A. L. 02934
Oil shale
Alaska
Arctic Slope, possibilities: Donnell, John R. 02704
Colorado
Piceance Creek basin, Green River shale, nahcolite–dawsonite content: Hite, Robert J. 02690
Oklahoma
Areal geology
Woods County, Oakdale oil and gas field: Thalman, A. L. 02934
Economic geology
Petroleum, Dalhart basin, occurrence: Dobervich, George. 03032
Petroleum, natural gas, exploration, Hartshorne Formation: McDaniel, Gary A. 03016
Petroleum, natural gas, Woods County, Red Fork sand: Thalman, A. L. 02934
Petroleum, northwestern, exploration, Red Fork sand: Withrow, Phil C. 03019
Geomorphology
Washita River basin, sediment transport: Allen, P. B. 02800
Mineralogy
Clay minerals, Arkoma basin, Atoka sands: Manley, Fred H., Jr. 02986
Paleontology
Palynomorphs, Quaternary, central, southeastern: Bond, Thomas Alden. 02543
Sedimentary petrology
Arkansas River water, clay mineral suites, variability: Weaver, Charles E. 02859
Arkoma basin, Spiro sands, depositional environment: Potts, Ray H. 03029
North-central, Foraker Formation, carbonate rocks: Mogharabi, Ataolah. 02571
Stratigraphy
Mississippian, Hugoton embayment area, trend-analysis: Schramm, Martin W., Jr. 03028
Mississippian–Pennsylvanian, Spiro sands, Arkoma basin: Potts, Ray H. 03029
Pennsylvanian, Red Fork sand, northwestern: Withrow, Phil C. 03019

Oklahoma
Structural geology
Dalhart basin, general: Dobervich, George. 03032
Ontario
Absolute age
Grenville province, Sudbury area, Rb–Sr whole rock: Davis, G. L. 02736
Areal geology
Abram Lake area, western: Johnston, F. J. 02542
Highway 101, Chapleau to Wawa: Giblin, P. E. 02551
Penhorwood township, Sudbury District: Milne, V. G. 02549
Reeves township, Sudbury District: Milne, V. G. 02548
South Trout Lake area: Ayres, L. D. 02550
Economic geology
Copper, zinc, Porcupine district, Canadian Jameison mines: Mining in Canada. 02630
Lead–zinc, Bruce Peninsula, Niagara escarpment, occurrence: Guillet, G. R. 02906
Mineral resources, Kapuskasing area, exploration, potential: George, P. T. 02901
Nickel–copper, Sudbury District, Strathcona mine, genesis: Naldrett, A. J. 02640
Ni–Cu ores, Sudbury area, experimental studies, genesis: Craig, J. R. 02644
Engineering geology
Clays, New Liskeard area, varved, foundation performance: Raymond, Gerald P. 02746
Clays, New Liskeard area, varved, foundation performance: Stermac, A. G. 02762
Maps, geologic
Abram Lake area, western: Johnston, F. J. 02542
Highway 101, Chapleau to Wawa: Giblin, P. E. 02551
Penhorwood township, Sudbury District: Milne, V. G. 02549
Reeves township, Sudbury District: Milne, V. G. 02548
Shaw township, Cochrane District: Carlson, H. D. 02547
South Trout Lake sheet: Ayres, L. D. 02550
Petrology
Brent Crater, alkaline carbonatite complex, not meteor crater: Currie, K. L. 02793
Sudbury District, Strathcona mine, sulfide distribution, pyroxene composition: Naldrett, A. J. 02640
Optical mineralogy
Indicatrix
Amphibole, glaucophane–riebeckite series: Borg, I. Y. 02672
Refractive index
Vaterite, quantitative interpretation: Donnay, J. D. H. 02639
Ordovician
Brachiopoda
Upper, atrypids, taxonomy, evolution, distribution: Boucot, A. J. 02885
Ordovician
Kansas
South–central, Sedgwick embayment, Simpson sandstone: King, Charles R. 03020
Kentucky
Brachiopoda, Lexington Limestone: Neuman, Robert B. 02767
Minnesota
Southeastern, Glenwood Formation: Parham, Walter. 02865
Pennsylvania
Dauphin County, Great Valley carbonate formations, revision: MacLachlan, David B. 02878
Oregon
Glacial geology
Wallowa Lake area, moraines, compound: Crandell, Dwight R. 02486
Maps, geologic
Crescent quadrangle, east half: Walker, George W. 02740
Paleontology
Mammalia, Tertiary, *Peromyscus*: Shotwell, J. Arnold. 02895
Petrology
Southwestern, blueschist belt below thrust, metamorphic zonation: Blake, M. C., Jr. 02462
Sedimentary petrology
Continental shelf, sediments: Gross, M. Grant. 02867
Crater Lake, sediments: Nelson, C. Hans. 02501
Wallowa Lake area, drift units, differentiation: Crandell, Dwight R. 02486
Stratigraphy
Cenozoic, Crescent quadrangle, east half, section: Walker, George W. 02740
Organic materials
Amino acids
Content in increasingly older fossils: Hare, P. E. 02732
Content in mollusks, shell and extrapallial fluid: Hare, P. E. 02733
Genesis on primitive Earth: Abelson, P. H. 02718
Genesis on primitive Earth: Abelson, P. H. 02730
Geochemistry
Asphaltic components of petroleum, colloidal form: Witherspoon, P. A. 02775
Precambrian rocks, criteria for sample selection: Hoering, T. C. 02734
Hydrocarbons
Aliphatic and alicyclic in asphalt, Trinidad: Ponnamperuma, Cyril. 02495
Geochemistry, petroleum porphyrins, properties: Hodgson, G. W. 02774
Migration, role of clay minerals in sediments: Weaver, Charles E. 02773
Paraffin
Genesis, from fatty acids, mathematical model: Kvenvolden, Keith A. 02496

Organic materials
Porphyrins
Geochemistry, properties, role in hydrocarbon migration: Hodgson, G. W. 02774
Orogeny
Laramide
Texas, Big Bend National Park, Tertiary deformation: Maxwell, Ross A. 02913
Mechanism
Controls, serpentine dehydration, effect: Scarfe, C. M. 02674
Precambrian
Greenland, Qagssimiut area: Ayrton, S. N. 02803
Ostracoda
Tertiary
North and South Carolina, Duplin and Waccamaw Formations, assemblages: Howard, James Franklin. 02611
Pacific Islands
Geomorphology
General: Thomas, William L., Jr. 02742
Marine geology
Structure, composition, origin: Thomas, William L., Jr. 02742
Pacific Ocean
Geomorphology
Landform evolution: King, Lester C. 02828
Paleontology
Man, fossil, Quaternary, Bering Sea area, migration and dispersal: Laughlin, W. S. 02450
Mollusca, Cenozoic, Atlantic origin, transarctic migration: Durham, J. Wyatt. 02428
Sedimentary petrology
Bering Sea, glacial and postglacial sediments: Gershanovich, D. E. 02453
Structural geology
Northeastern, northward motion of basin, effects: Stoneley, R. 02782
Paleobotany
Fossils, problematic
Wattia, n.gen., Permian, Texas: Mamay, Sergius H. 02481
Geographic distribution
North America, northwestern, Neogene–Pleistocene: Wolfe, Jack A. 02457
Permian
Texas, Arroyo Formation, affinities with Asia, Europe: Mamay, Sergius H. 02481
Pleistocene
Yukon, *Lupinus arcticus*, seeds, viable: Porsild, A. E. 02944
Quaternary
Alaska, Ogotoruk Creek flora, distribution, ecology: Johnson, Albert W. 02420
Paleoclimatology
Indicators
Continental shelf, sediment types: Hayes, Miles O. 02451
Quaternary
Alaska, Chukchi Sea coast: McCulloch, D. S. 02455
Paleoclimatology
Quaternary
Caribbean Sea, temperature curve: Donn, William L. 02834
North America, northern, Bering land bridge, mammal migrations: Flerow, C. C. 02460
Paleoecology
Cenozoic
Terrestrial, Arizona, San Pedro Valley: Gray, Robert S. 02853
Foraminifera
Paleocene, Alabama, Nanafalia Formation: Smith, Charles Culberson. 02875
Indicators
Lagoonal sediments, depositional record, biofacial zonation: Warme, John Edward. 02623
Marine sediment, polychaete reworking: Rhoads, Donald C. 02892
Mollusca
Experimental studies, shell geochemistry: Mitterer, Richard Max. 02570
Pelecypoda
Cretaceous, marine, North America, Western Interior: Kauffman, Erle G. 02988
Permian
Marine, Oklahoma, north-central, Upper: Mogharabi, Ataolah. 02571
Quaternary
New York, Long Island, late Pleistocene: Newman, Walter S. 02573
Sedimentation
Oklahoma, Arkoma basin, Spiro sands: Potts, Ray H. 03029
Tertiary
Marine, North and South Carolina, coastal plain: Howard, James Franklin. 02611
Paleogeography
Cenoyoic
United States, eastern, Cretaceous shoreline: Holsinger, John R. 02829
Cretaceous
Texas, Edwards Limestone area: Fisher, W. L. 02951
Devonian
Pennsylvania, eastern: Frakes, Lawrence A. 02882
Paleozoic
United States, early, midcontinent, southern: Chenoweth, P. A. 03021
Quaternary
North America, northern, Bering land bridge, mammal migrations: Flerow, C. C. 02460
Puerto Rico, island shelf, faunal indicators: Heatwole, Harold. 02989
Tertiary
California, Coast Ranges: Galehouse, Jon Scott. 02566
United States
Ordovician–Pennsylvanian, eastern interior, carbonate microfacies: Carozyi, Albert V. 02967

Paleomagnetism
Cenozoic
Nevada, Lousetown Formation, lava flow sequences: Heinrichs, Donald Frederick. 02624
Methods
A. C. bridge method, description: Fuller, M. D. 02517
A.C. demagnetization, technique: Doell, Richard R. 02535
Balance, Curie point, design: Clarke, H. C. 02519
Balance, recording magnetic design, application: Doell, Richard R. 02537
Data analysis, general approach: Doell, Richard R. 02536
Drill, large sampling, description: Opdyke, N. D. 02526
Drill, portable coring, description: Doell, Richard R. 02524
Instrument, technique, magnetic susceptibility anisotropy measurement: Graham, John W. 02518
Instruments, magnetometer, automatic 3 magnet: Larochelle, A. 02923
Low-temperature analysis, magnetic phase identification: Fuller, M. D. 02869
Magnetic anisotropy measurement: Cox, Allan. 02540
Magnetic shielding, analysis for design: Patton, B. J. 02812
Magnetometer, air-turbine spinner, portable: Helsley, Charles E. 02530
Magnetometer, astatic, Canada, Dominion Observatory: Roy, J. L. 02522
Magnetometer, astatic, techniques of use: Roy, J. L. 02532
Magnetometer, 2-component, design, use: Hodych, J. P. 02813
Magnetometer, fluxgate, application, Curie points: Weijts, A. G. L. M. 02538
Magnetometer, N.R.M.-measurement in situ: Doell, Richard R. 02531
Magnetometer, resonance, evaluation: Graham, John W. 02527
Magnetometer, short-period resonance: Farrell, W. E. 02528
Magnetometer, spinner, advantages: Doell, Richard R. 02533
Magnetometer, spinner, description, application: Gough, D. I. 02520
Magnetometer, spinner types, design: Helsley, Charles E. 02529
Magnetometer, spinner, U.S. Geol. Survey, design, application: Doell, R. R. 02521
Magnetometer, vibration, design, advantage: Kobayashi, Kazuo. 02539
Rock sampling, considerations: Gough, D. I. 02523
Sampling, field-drilling, advantages: Helsley, Charles E. 02525
Permian
Prince Edward Island, basic sill, Malpeque Bay: Larochelle, A. 02809
Paleomagnetism
Quaternary
Arizona, Snaketown ruins, fire-pit clays: Weaver, Kenneth F. 02675
Reversals
Sea-floor spreading evidence, mid-Atlantic Ridge: Phillips, J. D. 02665
Tektite association, significance: Glass, B. P. 02687
Stability tests
Field, advantages: Strangway, D. W. 02534
Triassic
Nova Scotia, North Mountain Basalt: Larochelle, A. 02809
Quebec, Manicouagan Group: Larochelle, A. 02438
Paleontology
Environmental analyses
Mollusca, shell geochemistry, amino acids, proteins: Mitterer, Richard Max. 02570
Life, origin
Primitive Earth, prebiologic chemical reactions: Abelson, P. H. 02718
Methods
Vertebrate microfossils in matrix, transportation by helicopter: Downs, Theodore. 02915
Migrations
Bering land bridge: Hopkins, David M. 02418
Nomenclature
Trace fossils, binomial proliferation, protest: Branson, Carl C. 02904
Paleozoic
Nova Scotia
Meguma Group, paleocurrent and basin analysis: Campbell, F. H. A. 02823
Texas
Big Bend National Park, stratigraphy: Maxwell, Ross A. 02908
United States
Eastern interior, Ordovician-Pennsylvanian, carbonate microfacies: Carozzi, Albert V. 02967
Midcontinent, southern, stratigraphy: Chenoweth, P. A. 03021
Palladium
Analysis
Spectrophotometric with p-nitrosodimethylaniline: Grimaldi, F. S. 02485
Palynology
Environment analysis
Deposition rates, lakes, New England: Davis, Margaret B. 02500
Quaternary
Alaska, arctic lowlands and Bering Sea islands: Colinvaux, Paul A. 02419
New York, Long Island-Staten Island, late Pleistocene: Sirkin, Leslie A. 02574
Oklahoma, central, southeastern: Bond, Thomas Alden. 02543
Paragenesis
Fluorite-sphalerite
Illinois, southern: Amstutz, G. C. 02820

Paragenesis
Skarn deposit
Nevada, Tem Piute: Buseck, Peter R. 02695
Sulfide nodules
Greenland, Ivigtut siderite–cryolite ore, pyrrhotite and marcasite: Soen, Oen Ing. 02804
Pelecypoda
Mercenaria
Tertiary–Quaternary, nonprotein amino acid ratios: Hare, P. E. 02732
Tertiary–Quaternary, nonprotein amino acid ratios: Hare, P. E. 02732
Pegmatite
Genesis
Tectonic–hydrothermal, model: Gresens, Randall L. 02329
Paragenesis
Sulfide nodules
Greenland, Ivigtut siderite–cryolite ore, pyrrhotite and marcasite: Soen, Oen Ing. 02804
Pelecypoda
Mercenaria
Tertiary–Quaternary, nonprotein amino acid ratios: Hare, P. E. 02732
Pennsylvania
Economic geology
Mineral resources, Erie County: Tomikel, John C. 02747
Geochemistry
Lancaster quadrangle, ground water, Ca–Mg ratio, correlation with source rocks: Meisler, Harold. 02595
Geomorphology
Erie County, landform description: Tomikel, John C. 02747
Glacial geology
Erie County, deposits, drainage effects: Tomikel, John C. 02747
Hydrogeology
Lancaster quadrangle, ground water, Ca–Mg ratio, correlation with source rocks: Meisler, Harold. 02595
Maps, geologic
Bangor quadrangle: Davis, Robert E. 02723
California quadrangle: Schweinfurth, Stanley P. 02722
Dauphin County, Cambrian–Ordovician carbonate rocks: MacLachlan, David B. 02878
Sedimentary petrology
Clearfield County, underclays, postdepositional alteration, criteria: Jaron, Michael G. 02868
Eastern, Devonian, Trimmers Rock Member of For. Littleton Formation: Frakes, Lawrence A. 02882
Kittanning Formation, channel sandstone: Beutner, Edward C. 02583
Stratigraphy
Bangor quadrangle, sections: Davis, Robert E. 02723
Pennsylvania
Stratigraphy
Cambrian–Ordovician, carbonate formations, revision, Dauphin County: MacLachlan, David B. 02878
Devonian, Trimmers Rock Member, Fort Littleton Formation, paleogeography: Frakes, Lawrence A. 02882
Devonian–Pennsylvanian, Erie County: Tomikel, John C. 02747
Pennsylvanian, Kittanning Formation, Philipsburg area: Beutner, Edward C. 02583
Pennsylvanian–Permian, Quaternary, California quadrangle, section: Schweinfurth, Stanley P. 02722
Structural geology
Dauphin County, Great Valley, thrusts, displacement: MacLachlan, David B. 02878
Pennsylvanian
Indiana
Southwestern, stratigraphy: Rooney, Lawrence F. 02874
Kansas
Central, Cherokee sandstone: Mueller, George N. 03026
Kentucky
Western Kentucky coal field, No. 4 (Dawson Springs No. 6) bed: Kehn, T. M. 02585
Montana
Stratigraphy, boundary, lower: Maughan, Edwin K. 02431
New Mexico
Sacramento Mountains, Holder Formation: Wilson, James Lee. 02489
Oklahoma
Northwestern, Red Fork sand: Withrow, Phil C. 03019
Pennsylvania
Philipsburg area, Kittanning Formation: Beutner, Edward C. 02583
Permafrost
Canada
Distribution, zones: Brown, R. J. E. 02888
Engineering properties
Bibliography: U.S. Library of Congress. 02510
Permeability
Carbonate rocks
United States, midcontinent, oil accumulation: Harris, John F. 03024
Sandstone
Measurement, nuclear magnetic resonance, technique: Saraf, D. N. 02852
Permian
Arizona
Mogollon Rim, stratigraphy: Peterson, Willis. 02917
California
Amador and Calaveras Counties, Foraminifera, Calaveras Formation: Douglass, Raymond C. 02770
Nevada
Medicine Range, biostratigraphy: Collinson, James Waller. 02602

Permian
Nevada
Mount Velma quadrangle, Sunflower Formation, fauna: Hoare, Richard D. 02974
Oklahoma
North-central, Foraker Formation: Mogharabi, Ataolah. 02571
Texas
Baylor County, flora, Arroyo Formation, affinities with Asia, Europe: Mamay, Sergius H. 02481
Petrofabrics
Granite
Northwest Territories, Basler-Eau Claire complex: Smith, Peter Henderson. 02620
Metamorphic rocks
Colorado, Puma Hills: Wobus, Reinhard Arthur. 02579
Petroleum
California
Castaic Junction field, occurrence: Cordova, Simon. 02935
Edison field, Main area, occurrence: Barnes, J. A. 02940
Long Beach field, Recreation Park area, occurrence: Ingram, William L. 02936
Ojai field, North Sulphur Mtn. area, occurrence: Mitchell, William Spencer. 02941
Canada
Exploration, western, neutron log: Smith, W. D. M. 02831
Colorado
Las Animas arch, occurrence: Clair, Joseph R. 03031
Exploration
Hydrogeologic data, importance: Dickey, Parke A. 03027
Methods, sediments, directional, scalar properties: McDaniel, Gary A. 03016
Genesis
Asphaltic components, role in accumulation: Witherspoon, P. A. 02775
Migration and accumulation, mechanism: Baker, E. G. 02776
Porphyrins, metal ion exchange, role in migration: Hodgson, G. W. 02774
Geochemistry
Asphaltic components, role in accumulation: Witherspoon, P. A. 02775
General, symposium: Nagy, Bartholemew. 02772
Porphyrins, metal ion exchange, role in migration: Hodgson, G. W. 02774
Illinois
Production zones, maps: Howard, Richard H. 02679
Kansas
Central, possibilities, Cherokee sand: Mueller, George N. 03026
Northeastern, Abilene-Nemaha anticline, possibilities: Brown, Donald M. 03030
Petroleum
Kansas
Sedgwick embayment, occurrence, exploration, production: King, Charles R. 03020
Southwestern, resources, Chester sandstones: Marden, D. W. 03025
Mexico
Chiapas, Teopisca Comitan area, possibilities: Alvarado Ortuno, Jorge E. 02796
Missouri
Western, resources, heavy oil: Anderson, K. H. 03022
Oklahoma
Dalhart basin, occurrence: Dobervich, George. 03032
Northwestern, exploration, Red Fork sand: Withrow, Phil C. 03019
Woods County, Oakdale field, Red Fork sands, occurrence, resources: Thalman, A. L. 02934
Production
Nuclear explosions, methods: Mickey, W. V. 02850
Source rocks
Clay mineralogy, significance in migration: Weaver, Charles E. 02773
Texas
Dalhart basin, occurrence: Dobervich, George. 03032
United States
Midcontinent, resources, carbonate rock reservoirs: Harris, John F. 03024
Petrology
Methods
Statistical, correlations between ratios: Chayes, F. 02735
Phase equilibria
Acmite
Melting relations at high pressures: Gilbert, Charles M. 02662
Albite-anorthite
Melting relations, high pressures: Lindsley, D. H. 02656
Albite-anorthite-forsterite
Phase relations, 1 atm.: Schairer, J. F. 02657
Al-Mn-Fe-Si-O-H
Garnet, selected phase relationships: Hsu, Liang-chi. 02567
Apatite-iron oxide-silicates
Experimental studies: Philpotts, A. R. 02713
Basalt magma
Experimental studies: O'Hara, M. J. 02884
Bi-Mo-S
Experimental studies: Stemprok, M. 02632
Ca-Al-Si-O
P-T curves: Hays, James Fred. 02660
Cu-Ag-S
Geothermal brine, California: Skinner, Brian J. 02694
Cu-Fe-Ni-S
550°-650°C range: Craig, J. R. 02645
Cu-Fe-Pb-S
Stability limits, stable sulfide assemblages: Craig, J. R. 02634

Phase equilibria
Cu–Pb–S
Phase relations, 500°–600°C: Craig, J. R. 02633
Feldspar
Potassium feldspar melting relations to 40 kb: Lindsley, D. H. 02653
Fe–Mo–S
Pyrite–molybdenite solid solution limits: Kullerud, G. 02631
Fe–Ni–S
Fugacity of sulfur at 600°C: Naldrett, A. J. 02642
Fe–O–S–C
Sulfide paragenesis, Greenland, Ivigtut siderite–cryolite ore, nodules: Soen, Oen Ing. 02804
FeO–SiO_2
Pressure–temperature relations: Lindsley, D. H. 02659
Fe–Pb–S
Experimental studies, crystallization temperatures: Brett, Robin. 02696
Fe–S–O–H
Phase relations, 200°–300°C: Kullerud, G. 02635
Hedenbergite–ferrosilite
Phase relations: Lindsley, D. H. 02719
Instruments
Pressure measurements, single-stage apparatus: Boyd, F. R. 02726
Jadeite–diopside
Melting relations at 40 kb: Bell, Peter M. 02661
Kyanite–sillimanite
Pressure–temperature relations: Richardson, S. W. 02654
Mg–Fe–Si–OH
Serpentine stability, bearing on tectonic processes: Scarfe, C. M. 02674
Ni–Cu
Ontario, Sudbury area, Strathcona mine: Craig, J. R. 02644
PbO–Cr_2O_3–O_2
Experimental studies: Negas, Taki. 02717
PbO–SrO–O_2
Experimental studies: Negas, Taki. 02717
Pentlandite
Composition at 600°C: Craig, J. R. 02643
Temperature of formation, maximum: Craig, J. R. 02646
Pyrite
Temperature of formation, maximum: Craig, J. R. 02646
Pyroxene
Metamorphic assemblages, omphacite stability: Essene, E. J. 02673
Quartz
Solubility, variation with water fugacity, 400°–500°C: Sommerfeld, R. A. 02441
Quartz–coesite
Experimental studies, pressure measurement instrument: Boyd, F. R. 02726

Phase equilibria
Silicate liquids
Ferric–ferrous equilibrium, controls: Carmichael, I. S. E. 02444
Staurolite
Stability to 10 kb: Richardson, S. W. 02655
Sulfide–oxide
Spinel structure minerals, iron-deficient: Kullerud, G. 02729
Sulfur
Melting relations up to 20 kb by DTA methods: Bell, Peter M. 02728
Phosphate
North American
Resources, production, occurrence: Service, A. L. 02700
Resources
World, summary: Service, A. L. 02700
Utah
Resources, Phosphoria Formation: Coffman, J. S. 02701
Wyoming
Resources, Phosphoria Formation: Coffman, J. S. 02701
Phosphorus
Analysis
Activation, silicate rocks: Greenland, L. Paul. 02484
Geochemistry
Apatite, liquid immiscibility: Philpotts, A. R. 02713
Photogeology
Interpretation
Highway construction materials, sources investigation, Kansas: Stallard, Alvis H. 02964
Labrador
Churchill Falls area, hydroelectric project: Rivard, L. A. 02927
Measurements
Fracture traces, areal abundance: Trainer, Frank W. 02589
Placers
Gold
Alaska, south-central, Metal Creek area: Richter, Donald H. 02898
Popular and elementary geology
Arizona
Mogollon Rim: Peterson, Willis. 02917
California
Yosemite National Park, guidebook: Scharff, Robert. 02755
Porosity
Carbonate rocks
United States, midcontinent, oil accumulation: Harris, John F. 03024
Sandstone
Measurement, reduction under triaxial stress: Wilhelmi, Bernhard. 02838
Precambrian
Canada
Shield, geochronology, relation to mineral deposits: Sarcia, Jacqueline. 02971
Colorado
Puma Hills: Wobus, Reinhard Arthur. 02579

Precambrian
Greenland
Qagssimiut area, history: Ayrton, S. N. 02803
Montana
Beartooth Mountains, mafic dike swarms: Prinz, Martin. 02617
New York
Dekalb area, stratigraphy: Bloomer, R. O. 02497
Dekalb area, stratigraphy, reinterpretation: Brown, J. S. 02582
Newfoundland
Southeastern, absolute age, interpretation: Rose, E. R. 02900
Northwest Territories
Mackenzie, Basler–Eau Claire Granites: Smith, Peter Henderson. 02620
Organic materials
Criteria for study material: Hoering, T. C. 02734
Wyoming
Beartooth Mountains, mafic dike swarms: Prinz, Martin. 02617
Prince Edward Island
Paleomagnetism
Permian, basic sill, Malpeque Bay: Larochelle, A. 02809
Puerto Rico
Geomorphology
Rio Camuy Cave area, karst: Thrailkill, John V. 02741
Paleontology
Fauna, Quaternary, endemism, interisland similarity: Heatwole, Harold. 02989
Quaternary
Alaska
Arctic lowlands and Bering Sea islands, palynology: Colinvaux, Paul A. 02419
Bering land bridge, general: Hopkins, David M. 02418
Chukchi Sea coast, history: McCulloch, D. S. 02455
Gulf of Alaska, sediments: Gershanovich, D. E. 02453
Mammalia, pre-Wisconsin, list: Pewe, T. L. 02459
Ogotoruk Creek–Cape Thompson area, flora, distribution: Johnson, Albert W. 02420
Seward Peninsula, western, history: Sainsbury, C. L. 02456
Western, coastal areas, marine deposits, transgressions: Hopkins, David M. 02454
Alberta
Southwestern, Rocky Mountain and Laurentide tills: Wagner, William Philip. 02622
Arctic
Bering land bridge, general: Hopkins, David M. 02418
Indiana
West-central, Pleistocene stratigraphy: Schneider, Allan F. 02880
Quaternary
Man, fossil
Migrations, Bering land bridge: Muller-Beck, Hansjurgen. 02423
Manitoba
Tiger Hills region, glaciation, ice fluctuations, glacial lakes: Elson, John Albert. 02605
New Jersey
Southern, Pensauken Formation: Bowman, James Floyd, 2d. 02559
New York
Long Island, environments, late Pleistocene: Newman, Walter S. 02573
Long Island–Staten Island, chronology, late Pleistocene: Sirkin, Leslie A. 02574
Staten Island, Pensauken Formation: Bowman, James Floyd, 2d. 02559
North America
Beringia, history, Ogotoruk Creek flora: Johnson, Albert W. 02420
Mammalia, dispersions, correlations: Repenning, Charles A. 02458
Mammalia, migrations, Bering land bridge: Vangengeim, E. A. 02421
Mammalia, Soricidae, subfamilies, distribution, description: Repenning, Charles A. 02432
Northern, Mammalia, Asian source, Bering land bridge role: Flerow, C. C. 02460
Oklahoma
Central, southeastern, palynology: Bond, Thomas Alden. 02543
Pacific Ocean
Bering Sea area, Man, fossil, migration and dispersal: Laughlin, W. S. 02450
Bering Sea, sediments: Gershanovich, D. E. 02453
Puerto Rico
Paleogeography, faunal indicators: Heatwole, Harold. 02989
Shorelines
Research, INQUA committee: Fairbridge, Rhodes W. 02824
Utah
Bonneville Basin, Angiosperms, mimulus evolution: Lindsay, Delbert W. 02990
Bonneville basin, Pleistocene stratigraphy: Eardley, A. J. 02498
Washington
Klickitat River canyon, andesite flow: Sheppard, Richard A. 02469
Quebec
Geomorphology
Montreal area, Mount Royal massif, erosion: Ritchot, Gilles. 02791
Glacial geology
Montreal area, Mount Royal, erosion features: Ritchot, Gilles. 02791
Maps, geologic
Montreal area, St-Benoit and Terrebonne sheets, surficial: Ritchot, Gilles. 02881
Maps, geomorphologic
Montreal area, St-Benoit and Terrebonne sheets: Ritchot, Gilles. 02881

Quebec
Paleomagnetism
Triassic, Manicouagan Group: Larochelle, A. 02438
Paleontology
Invertebrata, Devonian, Gaspe Sandstone and Limestone: Boucot, A. J. 02808
Petrology
Titanium, apatite rocks: Philpotts, A. R. 02713
Stratigraphy
Devonian, Gaspe Sandstone and Limestone Groups: Boucot, A. J. 02808
Structural geology
Montreal area, Mount Royal intrusion, step-faulted flexure: Ritchot, Gilles. 02791
Radioactivity
Graywacke
California, Coast Ranges, northern: Wollenberg, Harold A. 02437
Sediments
Rate of deposition: Pollard, Lin Davis. 02887
Radium
Abundance
Sea water, plankton, Bahamas: Szabo, B. J. 02584
Rare earths
New Jersey
Northern, resources: Williams, Roger L. 02703
Utah
Moab area, borate nodules in marine evaporites, genesis: Raup, Omer B. 02467
Reefs
Alberta
Devonian, Cairn Formation, Miette area, biofacies: Noble, James Peter Allison. 02616
Mexico
Recent, Yucatan, Alacran Reef, sand cays: Folk, Robert L. 02848
New Mexico
Pennsylvanian, Holder Formation: Wilson, James Lee. 02489
Northwest Territories
Devonian, Middle,Root River: Brady, W. B. 02818
United States
Quaternary, Great Basin, pluvial lake basins, algal pinnacles: Johnson, G. A. L. 02720
Rhode Island
Maps, geologic
Chepachet quadrangle: Quinn, Alonzo W. 02769
Petrology
Chepachet quadrangle, bedrock: Quinn, Alonzo W. 02769
Stratigraphy
Precambrian–Mississippian, Chepachet quadrangle: Quinn, Alonzo W. 02769
Rivers
Channel geometry
Oklahoma, Washita River, relation to sediment in transport: Allen, P. B. 02800
Rivers
Drainage basins
Horton's Law of Stream Numbers, consistency: Smart, J. Samuel. 02799
Maryland
Potomac River, Point of Rocks area, base-flow study: Hanson, Ronald L. 02593
Meanders
Wavelength, relation to sediment load type: Schumann, S. A. 02684
Sediment transport
California, North Fork Eel River, bed material: Ritter, John R. 02594
Rocky Mountains
Mineralogy
Heavy minerals, central, Tertiary rocks: Sato, Yoshiaki. 02468
Sedimentary petrology
Central, Tertiary rocks, heavy mineral assemblages: Sato, Yoshiaki. 02468
Salt
Mexico
Gulf coast region, structure, production: Halbouty, Michel T. 02894
United States
Gulf coast region, structure, production: Halbouty, Michel T. 02894
Salt tectonics
Mexico
Gulf coast region, general: Halbouty, Michel T. 02894
United States
Gulf coast region, general: Halbouty, Michel T. 02894
Saskatchewan
Areal geology
Yorkton area: Cherry, John Anthony. 02561
Engineering geology
Slope stability, South Saskatchewan River damsite, failure: Bjerrum, Laurits. 02710
Sea water
Geochemistry
Radium content, Bahamas: Szabo, B. J. 02584
Sedimentary rocks
Carbonate rocks
Alteration, metamorphism, weathering, California: LaMarche, Valmore C., Jr. 02466
Geochemistry, carbon isotopic composition of biogenic: Weber, Jon N. 02727
Petrology, United States, eastern interior, Paleozoic microfacies: Carozzi, Albert V. 02967
Physical properties, porosity, permeability, U.S., midcontinent: Harris, John F. 03024
Chert
Physical properties, α-quartz cell parameters, variation with heat: Wilband, John T. 02957
Textures, Ohio, electron surface morphologies, aggregate solubility: Kneller, William A. 02958

Sedimentary rocks
Clastics
Provenance, Pennsylvania, Trimmers Rock Member of Fort Littleton Formation: Frakes, Lawrence A. 02882
Dolomite
Geochemistry, Ohio, analyses: Ingamells, C. O. 02494
Geochemistry, Texas, Edwards Limestone, diagenesis: Fisher, W. L. 02951
Graywacke
Radioactivity, California, northern Coast Ranges: Wollenberg, Harold A. 02437
Limestone
Experimental studies, solution kinetics: Howard, Alan D. 02816
Geochemistry, Ohio, analyses: Ingamells, C. O. 02494
Physical properties, strain hardening, Cordova Cream limestone: Cheatham, J. B., Jr. 02851
Lithofacies
New Mexico, southern, Holder Formation, shelf and basin cycles: Wilson, James Lee. 02489
Mineral composition
Clay minerals, significance in petroleum genesis: Weaver, Charles E. 02773
Physical properties
Correlation in porous formations, regression analysis: VonGonten, William Douglas. 02599
Sandstone
Physical properties, measurement, under triaxial stress: Wilhelmi, Bernhard. 02838
Physical properties, permeability, measurement method: Saraf, D. N. 02852
Provenance, Oklahoma, Arkoma basin, Atoka sands: Manley, Fred H., Jr. 02986
Shape analysis: Boggs, Sam, Jr. 02864
Shale
Mineral composition, provenance, Minnesota, Glenwood Formation: Parham, Walter. 02865
Underclay
Alteration, postdepositional, Pennsylvania: Jaron, Michael G. 02868
Sedimentary structures
Bedding
Colorado, Bijou Creek, flood deposits: McKee, E. D. 02857
Pennsylvania, Kittanning Formation, geometry: Beutner, Edward C. 02583
Crossbedding
California, Oceano area, coastal dunes: Matthews, Jerry Lee. 02613
Northwest Territories, Melville Island, Bjorne Formation, trend-surface analysis: Agterberg, F. P. 02832
Pennsylvania, Kittanning Formation: Beutner, Edward C. 02583
Current markings
Nova Scotia, Meguma Group: Campbell, F. H. A. 02823
Sedimentary structures
Current markings
Pennsylvania, Trimmers Rock Member of Fort Littleton Formation: Frakes, Lawrence A. 02882
Washington, sediments interbedded with basalt: Schmincke, Hans-Ulrich. 02942
Oolites
Bahamas, Bimini Lagoon, coating on carbonate grains: Bathurst, R. G. C. 02452
Florida, Miami Limestone, genesis, cf. Bahama Banks sedimentation: Hoffmeister, J. Edward. 02512
Slump structure
Arkansas, Fayetteville Formation: Spreng, A. C. 02866
Nova Scotia, Triassic(?) breccia in Windsor Group: Clifton, H. Edward. 02677
Tufa pinnacles
United States, Great Basin, algal precipitates: Johnson, G. A. L. 02720
Sedimentation
Cyclic
New Mexico, Pennsylvanian, Holder Formation: Wilson, James Lee. 02489
Red beds, development of coloration: Friend, P. F. 02783
Environment
Continental shelf, northwestern United States: Gross, M. Grant. 02867
Lagoon, ecological zoning, California, Mugu Lagoon: Warme, John Edward. 02623
Lake, Oregon, Crater Lake: Nelson, C. Hans. 02501
Lake, pollen, rates: Davis, Margaret B. 02500
Ocean, carbonate precipitation, lithification: Fischer, Alfred G. 02931
Experimental studies
Fluvial sandstone body, model: Potter, Paul Edwin. 02837
Marine shells, South Carolina, Georgia: Hoyt, John H. 02844
Ocean currents
Alaska, Barrow area, 1948–63: Hume, James D. 02680
Rates
Determination, gamma-ray spectrometry: Pollard, Lin Davis. 02887
Stream transport
Alluvial fans, processes, experimental and field: Hook, Roger LeB. 02933
Automatic analysis, tracer sand, particle counter: Teleki, P. G. 02854
California, North Fork Eel River, cobbles: Ritter, John R. 02594
River, flood deposition, Colorado: McKee, E. D. 02857
Yield rate, relation to geology, Oklahoma: Allen, P. B. 02800
Wind transport
Coastal dunes, California, Oceano area: Matthews, Jerry Lee. 02613

Sediments
Boulders
General description, dolomite boulder, continental slope off California: Pierce, J. W. 02835
Carbonate
General description, Bahamas, Bimini Lagoon, oolitic-coated grains: Bathurst, R. G. C. 02452
Geochemistry, diagenesis of skeletal: Land, Lynton S. 02836
Geochemistry, precipitation, lithification, off Barbados: Fischer, Alfred G. 02931
Mineral composition, distribution, Florida, Card Sound: Earley, Charles F. 02966
Clay
Mineral composition, clay minerals, Arkansas River water: Weaver, Charles E. 02859
Mineral composition, geochemistry, New York, Hudson estuary: McCrone, Alistair W. 02488
Size analysis, separation, techniques: Kerns, Raymond L., Jr. 02513
Diagenesis
Massachusetts, Cape Cod area, marine, biogenic reworking: Rhoads, Donald C. 02892
Environment
Continental shelf, inner, type, relation to climate: Hayes, Miles O. 02451
Estuary, diatomaceous sediments, British Columbia, Saanich Inlet: Gross, M. Grant. 02899
Lake, Oregon, Crater Lake: Nelson, C. Hans. 02501
Marine, Bering Sea, Gulf of Alaska, Quaternary: Gershanovich, D. E. 02453
River, Mexico, tropical, red bed genesis: Walker, Theodore R. 02492
General
General description, continental shelf, off Washington, Oregon: Gross, M. Grant. 02867
General description, flood deposits, Colorado: McKee, E. D. 02857
General description, Oregon, Crater Lake: Nelson, C. Hans. 02501
Mineral composition, provenance, Atlantic Ocean, Mid-Atlantic Ridge: Siever, Raymond. 02839
Geochemistry
British Columbia, Saanich Inlet, trace elements: Gross, M. Grant. 02899
Fatty acid and paraffin distribution, model: Kvenvolden, Keith A. 02496
Methods
Counter, grain and tracer, automatic fluorescent: Teleki, P. G. 02854
Freeze drying for disaggregation: Charm, Walter B. 02860
Particle-size analyzer, electronic: Boggs, Sam, Jr. 02864
Particle-size separation, clay: Kerns, Raymond L., Jr. 02513
Sediments
Methods
Square-rod piston sampler, lake sediments: Wright, H. E., Jr. 02858
Squeezer, water-removal, ocean deposits: Presley, Bob J. 02841
Mineral composition
Clay minerals, significance in petroleum genesis: Weaver, Charles E. 02773
Physical properties
Scalar, directional, application, oil-gas exploration: McDaniel, Gary A. 03016
Provenance
Atlantic Ocean, Gulf of Maine, nearshore, heavy mineral suites: Ross, David A. 02473
Gulf of Mexico, Sigsbee Deep, Quaternary: Harlan, Ronald Wade. 02609
Sand
General description, sand cays, Mexico, Alacran Reef: Folk, Robert L. 02848
Shape analysis
Sphericity: Boggs, Sam, Jr. 02864
Seismic methods
Interpretation
Automated technique, body waves: Archambeau, C. B. 03008
Digital experiments, data reduction, Northwest Territories, Yellowknife array: Weichert, D. H. 02514
Seismic array data, crustal studies, mathematical modeling: Kane, Julius. 03014
Objects
Petroleum, exploration, history, potential: Thralls, Hugh M. 03018
Reflection
Marine exploration for placer minerals, instruments: Miller, H. J. 02977
Subbottom profiling, narrow fiords: Rusnak, Gene A. 02474
Techniques
Wave radiation from moving source, calculation: Crosson, Robert Scott. 02603
Seismic surveys
Alaska
Gulf of Alaska, abyssal plains, reflection: Hamilton, Edwin L. 02439
Gulf of Alaska, echo sounding, review: McManus, Dean A. 02758
Resurrection Bay, cross sections: Rusnak, Gene A. 02474
California
Redondo submarine canyon, cross sections: Rusnak, Gene A. 02474
Continental margin
New England, Long Island Sound to Buzzards Bay, pre-Cretaceous surface: Tagg, A. Richard. 02475
Continents
Crustal studies, refraction profiles, re-interpretation: Landisman, M. 03011

Seismic surveys
Gulf Coastal Plain
Onshore–offshore experiment, preliminary report: Hales, A. L. 02668
Gulf of Mexico
Onshore–offshore experiment, preliminary report: Hales, A. L. 02668
United States
Crustal studies, northwestern: Chiburis, Edward Frank. 02562
Seismology
Elastic waves
Body waves, attenuation characteristic, power–law approximation: Strick, E. 02516
Body waves, deep–focus zones, mantle structure: Oliver, Jack. 02442
Body waves, interpretation, Bilby, Shoal, Fallon events: Archambeau, C. B. 03008
Compressional, attenuation in mantle, cf. shear waves: Kovach, Robert L. 03012
Compressional, mantle investigations: Sarmah, Suryya Kanta. 02576
Generation, release of internal strain in solid: Holstrom, Geoffrey Burwell. 02610
P , PcP waves, Longshot nuclear explosion, 0°–27°: Carder, Dean S. 02997
P waves, diffracted at core–mantle boundary, interpretation: Phinney, Robert A. 03013
P waves, short period, amplitudes, 30°–102° distance range: Cleary, John. 02446
Radiation from moving sources, mathematical analysis: Crosson, Robert Scott. 02603
S waves, traveltimes to North America, 28°–82°: Doyle, H. A. 03005
Velocities, profile in mantle: Toksoz, M. Nafi. 02503
Velocity, relation to rock density, seismic equation of state: Anderson, Don L. 02504
General
National Earthquake Information Center, services: Lander, James F. 02969
Observatories
Northwest Territories, Yellowknife array, data reduction method: Weichert, D. H. 02514
Shorelines
Changes
Alaska, Barrow area, sediment movement: Hume, James D. 02680
Intercontinental correlation, Georgia and S.W. Africa, Pleistocene: Hoyt, John H. 02814
Georgia
Pleistocene sea levels, correlation with S.W. Africa: Hoyt, John H. 02814
Research
Quaternary, INQUA committee: Fairbridge, Rhodes W. 02824
Silurian
Brachiopoda
Lower, atrypids, taxonomy, evolution, distribution: Boucot, A. J. 02885
Indiana
Southeastern, stratigraphy, conodont zones: Rexroad, Carl B. 02798
Silurian
Maine
Greenville quadrangle: Espenshade, G. H. 02763
Silver
Colorado
Mount Wilson quadrangle, occurrence, production: Bromfield, Calvin S. 02810
Geochemistry
Geothermal brine, California: Skinner, Brian J. 02694
Montana
Philipsburg district, occurrence: Prinz, William C. 02822
Nevada
Eureka County, resources, production: Roberts, Ralph J. 02975
Rowland quadrangle, resources: Bushnell, Kent. 02886
Tem Piute, occurrence: Buseck, Peter R. 02695
Washington
Republic mining district, occurrence, production: Muessig, Siegfried. 02436
Snow
Engineering properties
Bibliography: U.S. Library of Congress. 02510
Sodium carbonate
Colorado
Piceance Creek basin, Green River oil shale, possibilities: Hite, Robert J. 02690
Soils
Engineering geology
Automatic data processing, retrieval systems, descriptors: Am. Society of Civil Engineers. 02706
Clays, electrical response, structure: Arulanandan, Kandiah. 02556
Deformation tests, stress dilatance of feldspar: Lee, I. K. 02712
Research problems: Mason, Harold. 02739
Shearing behavior, Ottawa sand: Ko, Hon–Yim. 02711
Slope stability, dynamic strength tests: Lee, Kenneth L. 02709
Erosion
Creep, rate, theoretical model: Kirkby, M. J. 02932
Forest watersheds, susceptibility, factors: Dyrness, C. T. 02789
Hawaii, Oahu, multivariant analysis: Yamamoto, Teruo. 02801
Geochemistry
Cation exchange, clays, pH: deVilliers, J. M. 02995
Interlayer material, hydroxy–aluminum, infrared studies: Weismiller, R. A. 02994
Hydrogeology
Subsurface stormflow, forest soil experiments, seepage rate, depth: Whipkey, Ronald Z. 02786

Soils
Methods
Thin sections, preparation: Giles, Leland H. 02993
South Carolina
Absolute age
Botany Bay Island, marine shells, C-14: Hoyt, John H. 02844
Economic geology
Ceramic materials, sillimanite, concentration possibilities: Redeker, Immo H. 02845
Granite, monumental, Fairfield County, southwestern: Wagener, H. D. 02847
Heavy minerals, resources, exploration: Williams, Lloyd. 02924
Paleontology
Foraminifera, Ostracoda, Tertiary, Duplin and Waccamaw Formations, coastal plain: Howard, James Franklin. 02611
Stratigraphy
Tertiary, Duplin and Waccamaw Formations, coastal plain: Howard, James Franklin. 02611
South Dakota
Areal geolgy
Cascade Springs quadrangle: Post, Edwin V. 02870
Maps, geologic
Cascade Springs quadrangle: Post, Edwin V. 02870
Spectroscopy
Absorption
Atomic, Mg, Li, Zn, Fe determination, techniques: Abbey, Sydney. 02817
Atomic, technique, gold: Huffman, Claude, Jr. 02434
Gold, technique: Beevers, J. R. 02699
Photometric, palladium in rocks: Grimaldi, F. S. 02485
Activation analysis
Technique, silicate rocks, phosphorus determination: Greenland, L. Paul. 02484
Emission
Direct-current arc in argon, silicates and carbonates, volatile elements: Annell, Charles. 02483
Optical, direct reading: Cruft, E. F. 02692
Infrared
Emission, measurement, multiple-scan interferometer: Low, M. J. D. 02749
Statistical measures
Correlation coefficient
Test of significance, paleotemperature curves: Donn, William L. 02834
Statistical methods
Economic geology
Discriminant analysis, assay data: Link, Richard F. 02702
General, ore reserve calculations: Hazen, Scott W., Jr. 02956
Engineering geology
Variance analysis, limestone properties: West, Terry R. 02965
Statistical methods
Geomorphology
Multivariant analysis, Hawaii, soil erosion: Yamamoto, Teruo. 02801
Mining geology
General, mineral-deposit sampling, research review: Hazen, Scott W., Jr. 02509
Petrology
General, correlations between ratios: Chayes, F. 02735
Sedimentary petrology
Regression analysis, physical properties, correlation: VonGonten, William Douglas. 02599
Trend-surface analysis, structure orientations, Northwest Territories: Agterberg, F. P. 02832
Stratigraphy
General, United States, midcontinent, application: Campbell, R. L., Jr. 03015
Trend-surface analysis, oil, gas exploration: Schramm, Martin W., Jr. 03028
Stocks
Structure
New Mexico, Burro Mountains, Tyrone stock: Gillerman, Elliot. 02697
Stratigraphy
Methods
Dipmeter techniques, application, midcontinent: Campbell, R. L., Jr. 03015
Synthesizing sections, fluvial sandstone: Potter, Paul Edwin. 02837
Nomenclature
Texas, Big Bend National Park, Cretaceous-Tertiary, unit names: Maxwell, Ross A. 02910
Structural geology
Bibliography
Salt domes, United States, Mexico, Gulf coast region: Halbouty, Michel T. 02894
Methods
Airphoto interpretation, fracture traces, areal abundance: Trainer, Frank W. 02589
Slip-line orientations from fold geometry: Hansen, Edward. 02737
Textbooks
Laboratory manual, introductory: Zumberge, James H. 02914
Sulfur
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Geothermal brine, California: Skinner, Brian J. 02694
Surveys
Canada Geological Survey
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Tectonics
Alaska
Strike-slip faults, regional trends, oroclinal bending, evolution: Grantz, Arthur. 02607

Tectonics
Alpine structure
Slip-line orientations, Caledonides, Alps, Appalachians: Hansen, Edward. 02715
Processes
Sea-floor spreading, mid-Atlantic Ridge, magnetic evidence, rate: Phillips, J. D. 02665
Sea-floor spreading, rate, steady state: Vogt, Peter R. 02794
Sea-floor spreading, relation to local topography and second layer thickness: Menard, H. W. 02669
Recent deformation
Crust, electronic measurement, error correction: Thompson, M. C. 02996
Vertical tectonics
Stepped subsidence, cyclic sedimentation: Bott, M. P. H. 02779

Tektites
Genesis
Cosmic body collisions, magnetic field reversal evidence: Glass, B. P. 02687
Devitrification experiments: Wosincki, J. F. 02795

Tertiary
Alabama
West-central, Nanafalia Formation, Foraminifera: Smith, Charles Culberson. 02875
Alaska
Flora, Neogene distribution, stages: Wolfe, Jack A. 02457
California
Paleogeography, Paso Robles Formation, Pliocene: Galehouse, Jon Scott. 02566
Sacramento Valley, correlation sections, nomenclature: Sullwold, Harold H., Jr. 02926
Nevada
Medicine Range, stratigraphy: Collinson, James Waller. 02602
New Jersey
Coastal plain, Kirkwood Formation: Isphording, Wayne Carter. 02568
North America
Mammalia, Soricidae, subfamilies, distribution, description: Repenning, Charles A. 02432
Northwestern, flora, Neogene distribution: Wolfe, Jack A. 02457
North Carolina
Coastal plain, Duplin and Waccamaw Formations: Howard, James Franklin. 02611
Northwest Territories
Mackenzie, stratigraphy: Mountjoy, E. W. 02508
Oregon
Mammalia, *Peromyscus*, late: Shotwell, J. Arnold. 02895
Rocky Mountains
Central, correlation, heavy-mineral assemblages: Sato, Yoshiaki. 02468

Tertiary
South Carolina
Coastal plain, Duplin and Waccamaw Formations: Howard, James Franklin. 02611
Texas
Big Bend National Park, igneous activity: Lonsdale, John T. 02912
Big Bend National Park, Mammalia, Paleocene-Eocene: Wilson, John A. 02911
Big Bend National Park, stratigraphy: Maxwell, Ross A. 02908
Big Bend National Park, stratigraphy, correlation, new names, fauna: Maxwell, Ross A. 02910
United States
High Plains, northern, correlation, heavy-mineral assemblages: Sato, Yoshiaki. 02468
Washington
Yakima Basalt, paleomagnetism: Rietman, Jan David. 02618
Yukon
Northern, stratigraphy: Mountjoy, E. W. 02508

Texas
Areal geology
Big Bend National Park: Maxwell, Ross A. 02908
Economic geology
Petroleum, Dalhart basin, occurrence: Dobervich, George. 03032
Hydrogeology
Coleman County, aquifers and quality: Walker, Loyd E. 02756
Fayette County, ground water, resources: Rogers, Lowell Thompson. 02748
Jasper and Newton Counties, ground-water resources: Wesselman, J. B. 03000
Karnes County, connate water in Eocene sandstone, immobility: Manger, G. Edward. 02591
Montague County, ground water, resources and quality: Bayha, David C. 02925
Maps, geologic
Big Bend National Park: Maxwell, Ross A. 2908
Fayette County: Rogers, Lowell Thompson. 02748
Maps, ground water
Jasper and Newton Counties: Wesselman, J. B. 03000
Paleontology
Fauna, Paleozoic-Tertiary, Big Bend National Park: Maxwell, Ross A. 02910
Flora, Permian, Arroyo Formation, Baylor County: Mamay, Sergius H. 02481
Foraminifera, Cretaceous, Upper, Coastal Plain, planktonic: Pessagno, Emile A., Jr. 02760
Mammalia, Paleocene-Eocene, Big Bend area: Wilson, John A. 02911
Petrology
Big Bend National Park, intrusive igneous rocks: Lonsdale, John T. 02912

Texas
Petrology
Uvalde County, Cretaceous alkalic igneous rocks: Spencer, Alexander Burke. 02621
Sedimentary petrology
Edwards Formation, dolomite facies, diagenesis: Fisher, W. L. 02951
Stratigraphy
Cretaceous, Edwards Formation, paleogeography, dolomitization: Fisher, W. L. 02951
Paleozoic–Recent, Big Bend National Park: Maxwell, Ross A. 02910
Tertiary–Quaternary, Fayette County: Rogers, Lowell Thompson. 02748
Structural geology
Big Bend National Park, general: Maxwell, Ross A. 02913
Dalhart basin, general: Dobervich, George. 03032
Thermal springs
California
Brines, Salton Sea area: Skinner, Brian J. 02694
Nevada
Steamboat Springs, sulfuric acid production, bacteria in soil: Ehrlich, Garry G. 02478
Thermodynamic properties
Activity
Sulfur, geothermal brine, California: Skinner, Brian J. 02694
Heat of formation
Zoisite, muscovite, anorthite: Sommerfeld, R. A. 02893
Instruments
Pressure measurements, single-stage apparatus: Boyd, F. R. 02726
Trace-element analyses
Basalt
Spectrographic data: Lovering, T. G. 02479
Oil shale
Alaska, spectrographic: Donnell, John R. 02704
Shale
Nevada, Connors Pass quadrangle, Chainman Shale: Drewes, Harald. 02766
Tracks and trails
Classification
Functional, food gathering techniques, evolution: Seilacher, Adolf. 02688
Triassic
Arizona
Western, Moenave Formation, Whitmore Point Member: Wilson, Richard F. 02919
British Columbia
Vancouver Island, Buttle Lake area, Karmutsen Group: Surdam, Ronald Clarence. 02544
Nevada
Medicine Range, Thaynes Formation, biostratigraphy: Collinson, James Waller. 02602
Triassic
Northwest Territories
Melville Island, Bjorne Formation, paleocurrents: Agterberg, F. P. 02832
Nova Scotia
Limestone breccia in Mississippian Windsor Group: Clifton, H. Edward. 02677
Utah
Western, Moenave Formation, Whitmore Point Member: Wilson, Richard F. 02919
Trinidad
Geochemistry
Trinidad Lake asphalt, aliphatic and alicyclic hydrocarbons: Ponnamperuma, Cyril. 02495
Tungsten
Alaska
Chugach Mountains, Metal Creek area, exploration: Richter, Donald H. 02898
Nevada
Tem Piute, occurrence: Buseck, Peter R. 02695
United States
Earthquakes
Magnitude determination, regional and near-regional distances: Evernden, J. F. 03002
Economic geology
Industrial minerals, pozzolanic materials, natural sources, potential: Everett, Floyd D. 02959
Petroleum, exploration, philosophy, past and present: Thralls, Hugh M. 03018
Petroleum, midcontinent, carbonate rock reservoirs: Harris, John F. 03024
Phosphate, resources, production: Service, A. L. 02700
Salt, domes, Gulf coast region: Halbouty, Michel T. 02894
General
Geological surveys, history, training, research: Dunham, K. C. 02876
Geomorphology
Great Basin, pluvial lake basins, pinnacles, calcareous tufa: Johnson, G. A. L. 02720
Western, alluvial rivers, meander wavelength: Schumann, S. A. 02684
Geophysical surveys
Northwestern, seismic, crustal studies: Chiburis, Edward Frank. 02562
Mineralogy
Heavy minerals, High Plains, northern, Tertiary rocks: Sato, Yoshiaki. 02468
Paleontology
Malacostraca, Recent, eastern, amphipods: Holsinger, John R. 02829
Sedimentary petrology
Eastern interior, Paleozoic carbonate microfacies, photomicrographs: Carozzi, Albert V. 02967
Great Basin, tufa pinnacles, algal precipitation: Johnson, G. A. L. 02720

United States
Sedimentary petrology
High Plains, northern, Tertiary rocks, heavyminerals: Sato, Yoshiaki, 02468
Western, bentonite, characteristics, genesis: Menze, R. J. 02856
Stratigraphy
Cambrian–Ordovician, southern midcontinent: Chenoweth, P. A. 03021
Midcontinent, dipmeter data: Campbell, R. L., Jr. 03015
Ordovician–Pennsylvanian, eastern interior, carbonate microfacies: Carozzi, Albert V. 02967
Structural geology
Gulf coast region, salt tectonics: Halbouty, Michel T. 02894

Uranium
Colorado
Ralston Buttes district, occurrence: Sheridan, Douglas M. 02768

Utah
Earthquakes
1850–1965: Cook, Kenneth L. 03004
Economic geology
Phosphate, resources, Phosphoria Formation: Coffman, J. S. 02701
Geochemistry
Bonneville Salt Flats, brine, ion activity products, calculation: Polzer, W. L. 02480
Mineralogy
Rare-earth borate, Moab area, Hermosa Formation, new: Raup, Omer B. 02467
Paleontology
Angiosperms, Quaternary, Bonneville Basin, mimulus: Lindsay, Delbert W. 02990
Petrology
Cherry Creek area, breccia pipes: Morris, Hal T. 02471
Stratigraphy
Permian, Phosphoria Formation: Coffman, J. S. 02701
Pleistocene, exposed cf. subsurface sections, Bonneville basin: Eardley, A. J. 02498
Triassic(?), Moenave Formation, Whitmore Point Member, new: Wilson, Richard F. 02919

Vermont
Petrology
Regional metamorphic zones, zircon alteration: Gastil, R. Gordon, 02499

Virginia
Economic geology
Titanium, Nelson County, nelsonite: Philpotts, A. R. 02713
Maps, geologic
Southern, sulfide belt: Kinkel, Arthur R., Jr. 02753
Structural geology
Front Royal area, airphoto interpretation, fracture traces, abundance: Trainer, Frank W. 02589

Virginia
Structural geology
Shenandoah Valley, step-faulted basin, mechanism: Bott, M. P. H. 02779

Volcanoes
Hawaii
Hawaii Island, Kapoho, secondary impact craters: Hartmann, William K. 02985
Kilauea, summit deflation after May 1963 earthquakes: Kinoshita, Willie T. 02587
Mexico
Paricutin Volcano, effects, xylem growth patterns: Eggler, Willis A. 02983
Oregon
Mount Mazama, ash fall in Willapa submarine canyon, Washington: Royse, Chester F., Jr. 02757

Washington
Absolute age
Volcanic ash, C-14, Willapa submarine canyon: Royse, Chester F., Jr. 02757
Areal geology
Republic, Aeneas quadrangles: Muessig, Siegfried. 02436
Economic geology
Gold and silver, Republic mining district: Muessig, Siegfried. 02436
Maps, geologic
Republic and Aeneas quadrangles: Muessig, Siegfried. 02436
Paleomagnetism
Tertiary, Late Yakima Basalt: Rietman, Jan David. 02618
Petrology
Columbia River basalts, flow direction: Schmincke, Hans-Ulrich. 02942
Klickitat River canyon, andesite flow, K-rich: Sheppard, Richard A. 02469
Sedimentary petrology
Continental shelf, sediments: Gross, M. Grant. 02867
South-central, sediments interbedded with basalt, paleocurrents: Schmincke, Hans-Ulrich. 02942
Willapa submarine canyon, ash layer in core, Mazama origin: Royse, Chester F., Jr. 02757
Stratigraphy
Miocene–Pliocene, Yakima Basalt, correlation by remanent magnetism: Rietman, Jan David. 02618

Weathering
California
White Mountains, limestone and dolomite, metamorphosed: LaMarche, Valmore C., Jr. 02466
Dolomite
Metamorphosed, spheroidal, California, White Mts.: LaMarche, Valmore C., Jr. 02466
Limestone
Metamorphosed, spheroidal, California, White Mts.: LaMarche, Valmore C., Jr. 02466

Weathering
Massachusetts
Boston area, kaolinization of bedrock: Kaye, Clifford A. 02586
Mexico
Tabasco, red bed genesis: Walker, Theodore R. 02492
Mineralogy
Georgia, Altamaha River watershed, granite, gneiss, amphibolite: Jinks, Douglas David. 02626
Tropical climate
Mexico, red bed genesis: Walker, Theodore R. 02492
Well logging
General
Instrumentation, magnetic tape recording system: Keys, W. Scott. 02597
Nuclear magnetic
Experimental study, effect of oil bearing pores on signal: Devereux, Owen F. 02806
Radioactivity
Methods, neutron lifetime: Smith, W. D. M. 02831
Wells and drill holes
Texas
Coleman County, well and spring records: Walker, Loyd E. 02756
Jasper and Newton Counties, records of wells, drillers' logs: Wesselman, J. B. 03000
Montague County, records of wells and springs: Bayha, David C. 02925
Wisconsin
Geomorphology
Saint Croix River, ice, configuration, relation to bed roughness: Carey, Kevin L. 02592
Wyoming
Economic geology
Bentonite, Black Hills district: Menze, R. J. 02856
Phosphate, resources, Phosphoria Formation: Coffman, J. S. 02701
Glacial geology
Teton Glacier, rate of movement, thickness, resurvey 1966: Reed, John C., Jr. 02487
Maps, geologic
Driggs (Idaho) quadrangle: Pampeyan, Earl H. 02896
Mineralogy
Leucite Hills, volcanic wyomingite, orendite, madupite: Carmichael, Ian S. E. 02664
Petrology
Beartooth Mountains, mafic dike swarms: Prinz, Martin. 02617
Leucite Hills, volcanic wyomingite, orendite, madupite: Carmichael, Ian S. E. 02664
Stratigraphy
Permian, Phosphoria Formation: Coffman, J. S. 02701
Structural geology
Beartooth Mountains, mafic dike swarms: Prinz, Martin. 02617